SCIENTIFIC AMERICAN SUPPLEMENT

Scientific American Supplement, Vol. II., No. 39.
Scientific American, established 1845.
New Series, Vol. XXXV., No. 13.

NEW-YORK, SEPTEMBER 23, 1876.

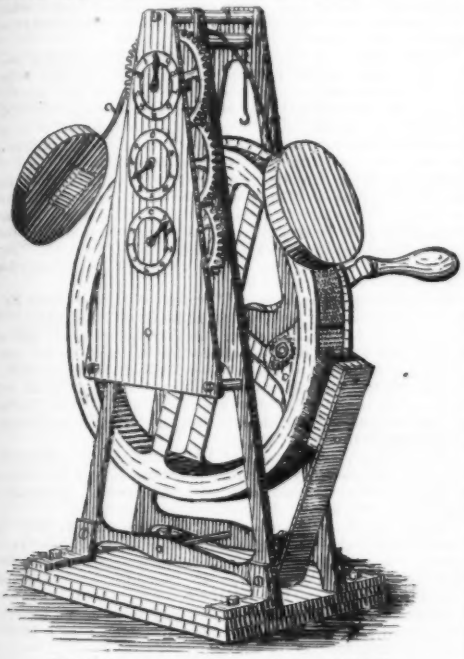
Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.
Postage free to Subscribers.

SKETCHES FROM THE EXHIBITION.

THE NAPMETER.

THE name of this instrument, although given to it by the inventor, Prof. Modest Kittary, President of the Technical Committee of General Intendancy of the Russian Ministry of War, hardly conveys the real object of the machine, of which we give a sketch.

By referring to the sketch it will be seen that the instrument consists mainly of a double-flanged wheel, faced with leather between the flanges, and having two rasps hung and weighted so as to bear upon that face; also an ordinary set of counting-wheels and dial-plates, to show the number of revolutions of the flanged wheel. The cloth to be tested is wound in a narrow strip around the leather face and secured, a light brush is provided to remove the dust, the rasps brought to bear upon the cloth, and the number of turns of the crank required to wear the cloth threadbare and smooth gives a comparative test of its durability and wearing qualities—a simple, inexpensive thing, but, as used by the Russian Ministry of War, it is safe to advise all shoddy contractors to stand clear. As evidence of its usefulness it is stated that a piece of the cloth furnished to the depot at Moscow, in 1870, stands the test of 700 revolutions on this instrument, while several pieces from different manufacturers, but all claiming to be of the same quality, and furnished to the same depot in 1875, stood only 200 revolutions, showing a difference in wearing qualities of three and a half to one.



RUSSIAN NAPMETER AT THE EXHIBITION.

Of the causes that led to the introduction of this instrument, we are told that the yearly competition brought the price of the cloth down in twelve years from $1.62 per yard to $1.12, while the wool market showed no such change. The cloth was required to be of a given weight and given number of threads per square inch, and also to have a certain tensile strength; every piece was weighed, and every twentieth piece was tested on the other points.

These conditions were clearly defined, but the decrease in price was made up by the contractor by using an inferior quality of wool—wool that had been injured by the lime of the tanneries, and which, although it might look fair to the eye and have full weight, did not wear well, being rendered brittle and rough by the action of the lime—and to test this point the napmeter was devised. Would not Uncle Sam do well to obtain such an instrument for use by army and navy inspectors, and also in the Indian supply contracts? Which of the present political parties will first put such a plank in their platform?

STEEL TESTS.

The exhibit of the tests and experiments of Mr. David Kirkaldy upon the Swedish steel from the Fagersta Works of Mr. Christian Aspelin, shown in the Swedish department of the Main Building, is interesting not merely as an exhibit of this particular brand of steel, which shows very perfect results, but it is even more interesting as an example of the care and judgment required to give such comparative tests any real value. Luckily in this case we have not only the reputation—high as it is—of Mr. Kirkaldy to depend upon, but he also comes forward and gives the details of the objects sought and methods employed, as well as the results obtained, and gives us many useful points for comparison and consideration in estimating or constructing, in all work where the strength of the metal is definitely called into question.

There is a boldness worthy of imitation in Mr. Kirkaldy's declaration "that the whole of the specimens were tested and the results fully recorded by himself personally;" "that as all the tables and diagrams were printed under my direction, and having gone over all the figures, I am responsible for their accuracy and for their appearance;" and "that I have concealed no facts, but have endeavored to present the whole in the most convenient form I could devise for the comparison of the facts elicited." There is a certain manly ring about these declarations that begets confidence.

In the tables and accompanying remarks are found the results of the experiments, testing the metal in the following different ways: 1st, pulling; 2d, thrusting; 3d, bending; 4th, twisting; 5th, shearing; and 6th, bulging. In the first four are given the elastic stress, or that which is required to stretch or bend the metal to a "set," or the point from which it refuses to spring back (and it is to be regretted that the same point is not given in regard to the bulging tests), and the ultimate, or stress at which the metal gave way; also we find the characteristics of the manner of giving way, and the various appearances of the fractures, with comments upon their causes. Thus, in the remarks upon the experiments with pulling stress, it is claimed that the fan-like appearance of the granular fracture is due to inequality in the metal, and not in the strain applied; and it is also stated that a very slight cause will produce or effect such appearances, which is undoubtedly true; and as in most shops such accurate machinery is not at hand, the fracture for examination often being obtained by the blow of a hammer, it is manifest that, such causes being many, unknown, and entirely uncontrolled, such fan-like effects have in general but very slight bearing on the question of quality—that is to say, that, upon breaking two bars, both of the same granular quality, but one showing a fair surface and the other a fan-like break, there is no difference of quality in the bars to be assumed from that difference of fracture.

The contraction of the area of the specimens at the fracture as an indication of the ductility is interesting; but why is the contraction in length neglected in the tests for torsion? A comparison of the area in the centre of the twist with the difference of length before and after twisting in the different specimens, would have been curious and interesting. For if we consider a bar as made up of a bundle of concentric courses or layers of wire, and twisted, the centre wire would remain unchanged, while the next series would stand deflected to one side, and each layer from there-out would show greater deflection than its predecessor. But the distance from end to end of the bar is greater on the spiral than on the centre, or a parallel thereto: hence, if the wires have cohesion enough among themselves not to slip, either the centre one must take a thrusting strain and decrease in length with corresponding increase of diameter, or the outer ones must take a pulling strain with corresponding decrease in diameter; and the conflict between these two actions is the labor of the metal, that, when carried far enough, must result in a breaking of the cohesive force that holds the wires together, or a fracture of the wires themselves—in many cases it will be found that both of these causes obtain to some degree, and the bar appears to change both in area and in length. This appearance may be wholly deceptive, and the ends of the bar prove to be convex, showing contraction in length at the circumference only, while the decrease in area would probably be found greatest in square or flat bars; but any data upon these points from Mr. Kirkaldy could hardly fail to be both instructive and interesting.

In the shearing test the results of "these experiments and many others before and since made, both on wrought-iron and steel, prove that the strength to resist a shearing is on an average one fourth less than that to resist a pulling stress, whereas writers have generally assumed that the shearing was equal to the tensile strength."

In the experiments upon steel ingots six inches square, to ascertain the mechanical effects produced by their being hammered down to five, four, three, and two inches square bars," the various ingots and bars were cut so as to give duplicate specimens: one set were tested as received, and without being heated," described as unannealed; the other set as annealed—which were all heated to a "blood red" in a suitable furnace, then covered up and allowed to cool very slowly.

"The differences between the unannealed and the annealed are more marked when we compare the elastic than when we compare the ultimate stress borne, the differences being considerably greater in the hardest ingot. As regards the strength, both elastic and ultimate, of the steel as cast in ingots six inches square, having consequently an area of thirty-six square inches, and when hammered down to bars two inches square, having an area of four square inches, or to one ninth part, we will first consider those specimens that were unannealed. These results show that the increase in strength due to hammering is not constant for the four classes—nay, more, that whilst the increase is greatest in the softest material under elastic stress, it is just the reverse under ultimate stress, the hardest material yielding the highest increase; this is also confirmed by those that were annealed. When we come to consider in a similar manner the effects of additional work expended in hammering bars from three inches to a half inch square, we shall find the same characteristics prevailing. Condensing the results, we have 33.3 per cent as the gain in strength of the steel when comparing that in the six-inch ingots and that hammered down to two-inch square bars.

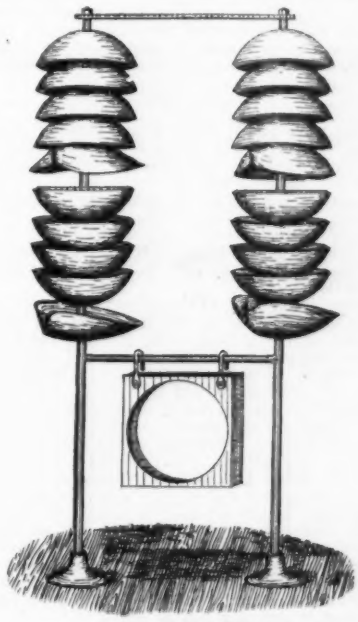
"Hammering also increases the ductility of the material, as proved by the specimens becoming more contracted in area at fracture, and also by the increase in the ultimate extension. It thus appears that the gain of 33.3 per cent, as arrived at in the preceding paragraph, is only a part of the actual benefit derived, by subjecting the material to the additional treatment by hammering.

"Whilst hammering increases the ductility, these experiments further prove that the stress must be increased to produce the same amount of extension. In order to ascertain this correctly, the extension of every specimen under certain loads was duly recorded.

"The increased ductility due to hammering is further attested by the change in the appearance of fractured specimens. The change in ingot 0.8 (the hardest) is not so marked, as both present a granular appearance, but of a finer character in the two-inch bars; whereas in ingots 0.4 and 0.2 the appearance in the casting was wholly granular and a right-angled fracture, which proves that the specimen more or less suddenly snapped, whereas the fractures in the two-inch bars were wholly silky and angular, or cup-formed, proving that these specimens rapidly extended, and had broken more or less gradually."

In the experiments upon bars rolled compared with bars hammered, we find that the elastic stress is considerably less in the rolled than in the hammered, while the ultimate stress varies comparatively little, and the extension at 50,000 lbs. per square inch strain is more in the rolled than the hammered, and also more in the three-inch bar than in the half-inch; and we are told that "ultimate extension is made up of two parts, which are due to different effects—namely, one to the general stretching of the specimens, the other to the sudden contraction of the bar at fracture. With hard materials, the ultimate extension is confined wholly to that arising from the general stretching; whereas in soft materials part is due to general stretching, and part, and that frequently the greater part, is due to the contraction of area at fracture.

"In order to make a satisfactory comparison of the ductility



STEEL TEST EXHIBITS.

of materials by means of the ultimate extension, it is absolutely necessary that the specimens should be of the same size, or approximately so, and also that the original length of the specimens should not vary."

In the experiments for the purpose of ascertaining the increase or decrease of length corresponding to various pulling or thrusting strains, it is remarked that "it has hitherto been assumed that the decrements corresponded with the increments within the elastic limit of the material. These experiments, however, prove that such is at least not always the case. The present experiments, with the exception of a few which I had previously made on wrought-iron, are the first experiments ever made to determine the actual facts by submitting 100 inch pieces cut from the same plate to pulling and thrusting stresses in the same testing-machine;" and "that steel can be made of different degrees of hardness is very important for engineering purposes; but it is no less important that the proper quality to resist the kind of stress that will come into play should be used."

In experimenting upon the effect of drilling or punching plates, one plate was prepared and punched; another exactly similar was drilled to match—the loss of area from the drilling or punching being in either case exactly 30.8 per cent. The result shows that in the drilled holes and with unannealed plates, the average loss of strength was 23.21 per cent, and with annealed plates the average loss was 24.92 per cent, or a total average of 24.06 per cent. "The loss was in no instance nearly so great as that representing the material removed, the mean being 24.06 against 30.80, or 6.94 per cent less."

Before saying that these results "must be wrong, let me again refer to my published experiments and to some of the conclusions arrived at. At page 94 it is stated: 48th. The breaking strain is materially affected by the shape of the specimen. Thus the amount borne was much less when the diameter was uniform for some inches of the length than when confined to a small portion—a peculiarity previously unascertained, and not even suspected."

With the punched holes, the unannealed plates gave a mean loss of 37.85 per cent; the loss from punching not being constant, but varying with the thickness and hardness of the materials. Punching also hardens the plate to some degree; and "heating and annealing the specimen after being punched is found to counteract to a considerable extent the injurious action. The mean loss of the five annealed is 31.63, and 37.85 in the unannealed, their joint average being 34.74 per cent. This average loss, however, would have been much greater had the material not been so extremely soft and ductile. The so-called theoretic loss of 30.8 per cent was found to be too high when the holes were drilled, and it is now found too low when the holes are punched, the actual loss in two of the cases referred to being 49.04 and 45.17 per cent."

The effects of the experiments for bulging stress are interesting, and as the test is not a common one, the table of the average ultimate stress is given below. These specimens were disks, twelve inches in diameter, cut in a lathe, and pressed through a hole ten inches in diameter, the end of the bulger being spherical in form, and turned to a five-inch radius. Ten pieces unannealed and ten pieces annealed were tested.

All of the specimens stood without cracking or exhibiting any defect, showing its superior quality, as only the better qualities of materials will stand this test without cracking, blistering, or showing signs of lamination.

TABLE OF ULTIMATE STRESS APPLIED.

Thickness.....	⅝	½	⅜	¼	⅛
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Unannealed.....	215,685	162,735	104,845	71,800	35,397
Annealed.....	198,005	154,230	95,605	59,425	25,435

"The original circumference of the specimen being 37.68 inches, and that of the aperture, 31.40 inches—difference, 6.28 inches, or 16.6 per cent, which is the amount of compression at the outer edge of the bowl. The material at the inner edge is still more compressed, the amount varying with the thickness. Thus we find in the five-eighth inch plate the inner diameter is 8.9 inches; circumference, 27.94 inches—difference, 9.74 inches, or 25.8 per cent, and the depth, 3.44 inches at the centre of the bowl."

The accompanying sketch represents these bowls as exhibited here. They are arranged upon two iron rods, which support between them a pack of square plates of the same metals, showing holes of the original size of the specimens before bulging. Without mark or label to show which were unannealed and which were annealed, the eye notes no difference, except thickness, and that all of the thinnest, or one-eighth, metal have wrinkled as shown in the drawing.

THE TYPE-WRITER.

For many years past there have been inventors striving to find a way to make single type-printing practically useful. Some, having turned their attention principally to the question of speed, claim to beat the most rapid penman, and make work that is fairly legible, while the question of fine workmanship has been too much neglected.

At last, however, appears the machine of M. Allisoff, a Russian, patented in this country. It is not yet manufactured for sale here, but may be seen in the Russian exhibit in Machinery Hall.

In this machine the paper to be printed upon is wound upon a cylinder that is moved to the types when the latter is in position, the requisite pressure being given by the foot. The types are arranged upon the face of a wheel or cylinder, by the revolution of which the proper letter is brought up facing the paper. Several rows of type are upon the cylinder, the shaft of which is supported by a sliding carriage, governed by a feed-screw and handle, so that either row of the types can be brought directly under the centre line of the paper cylinder as desired. Upon the shaft of this cylinder is a crank, by means of which it is revolved, and immediately behind the crank is a dial or face plate, marked with the various letters. The crank itself is hinged to the shaft, so that when turned to any particular letter it can be pressed back into a notch in the dial plate, that centres it and holds it in place, when, by pressing the foot upon the treadle, the feed and pressure of the paper upon the type is produced. When the line is finished, or the paper cylinder has completed its revolution, it strikes a bell as notice to set for another line.

The most peculiar feature of this machine is the arrangement for feeding the paper, or moving it the proper distance from one letter to another in the same word or line. For this purpose the shaft of the type cylinder carries, in addition to the type, another analogous cylinder provided with pins, agreeing in number and position with the type themselves, but varying in length in accordance with the varying spaces required by the type they represent; thus, upon bringing any letter up to print, the corresponding pin also comes up, and the downward motion of the paper cylinder is made to revolve the same until a tappet strikes the pin, when the revolution ceases, and the continued downward motion brings the paper into contact with the type. The upward motion of the cylinder continues the revolution from the time the tappet leaves the pin, so that the actual amount of the revolution from the centre of one space between two letters to the centre of the next such space, depends entirely upon the actual length of the pin corresponding to the included letter.

The machine is provided with capitals, small letters, figures, signs, etc., and as the ink-distributing roll has a narrow face only the row of type in use is inked, giving the most perfect work yet attained by any of its class. While, from its expensive construction, and the fact that it requires both eye and ear, as well as both hands and the foot, for even moderate speed, it can hardly in its present form become popular, still the fact is recorded that the most perfect workmanship in this line is performed by an invention that is not American.

MUSIC-PRINTING.

The inventor of the above machine, M. Allisoff, exhibits also a method of "setting up" music for the printer that is novel, and certainly appears well.

For this purpose, the usual notes and signs of the musician in all of their variety are printed on a large scale, on separate pieces of paper, and really represent so many type, being, like them, distributed into a "case."

Then taking a large plate of glass, and temporarily fixing behind it a sheet of paper with equidistant vertical and horizontal lines to guide the eye, strips of paper, with the horizontal lines of the music, are gummed upon the face of the glass, and upon these the paper notes and signs are also gummed, so as to show a finished page of music upon a magnified scale. The sheet of paper is now removed from the back, and the gum making the rest of the paper nearly transparent, a photographic negative of the music is easily obtained, reduced to any desired size, and, by the ordinary processes of photo-lithography or photo-engraving, the matter is reprinted without additional trouble, and the glass plate being washed off, another page is easily "set up" thereon. The work produced in this way will compare favorably with the standard work of the trade, while in the matter of expense it appears to be much cheaper. A. V.

HORTICULTURAL EXHIBIT AT THE CENTENNIAL.

It would be difficult to write a descriptive article to do full justice to the perfect beauty of the grounds surrounding the Horticultural building, at the Centennial Exhibition. It is doubtful if such a garden can be found anywhere else. The damp weather of the past few days has freshened up the grass and brightened up the flowers, until the whole grounds are fairly shining with bloom and verdure; and here it is proper to call attention to the fact that this outdoor department is quite as worthy of attention from the intelligent visitor as any thing exhibited in buildings. Great praise is frequently given to some exhibitor in a building for enterprise and liberality which has really cost but little, while here in the open grounds are thousands of dollars expended, and no small amount of labor and anxiety devoted by exhibitors, and yet comparatively few people stop to consider it, thinking the ornamentation of the grounds to be done merely for the gratification of the eyes of visitors. A large proportion of the plants and flowers are competitive exhibits, placed there at great expense and considerable risk, and all properly labelled and classified for the information of visitors and judges.

The amount of space devoted to the outdoor horticultural department is about 40 acres; the amount of space available for exhibitors, exclusive of walks, borders, buildings, and reserve space for ornamental gardening, is a little over 8 acres, or 282,673 square feet. The amount of space occupied by American exhibitors is 239,178 square feet; by foreign exhibitors, 43,500 square feet. Of these England occupies 8000 square feet; Spain, 8500 square feet; France, 15,000 square feet; the Netherlands, 6700 square feet; Germany, 4500 square feet, and Austria, 800 square feet. There are 56 exhibitors in the American section (not including those indoors) and 27 in the foreign section. The number of plants or other objects exhibited in the American section is 59,500, and in the foreign section, 10,233, divided as follows: England, 1801; Spain, 2038; France, 4164; The Netherlands, 1000; Germany, 1200, and Austria, 30.

The grounds west of Horticultural Hall are laid out with a parterre or sunken garden, extending to Belmont avenue, and showing several leading features in ornamental gardening, such as carpet bedding, where the beds are so laid out by the use of plants of various-colored bloom and foliage, to represent the figures in a carpet; ribbon gardening, where the various-colored plants are arranged in stripes, and geometrical gardening, where they are so planted as to form geometrical figures in the several colors. The vista commencing with the parterre was originally carried out to terminate with the large white marble fountain of the Catholic Total Abstinence Societies, but the erection of a wooden pagoda directly in the centre of Belmont avenue, over the ice-water fountain of the Sons of Temperance, has entirely cut off and destroyed the view west of the avenue.

East of the Horticultural Hall and between the building and the boundary fence is a large circular plot, containing in the centre a very beautiful large iron fountain, exhibited by the J. L. Mott Iron Works of New York; this is surrounded by thirteen flower beds in the form of large stars and planted with coleus, geraniums and other plants, giving solid masses of color. Scattered all around the grounds are fountains, statuary, kiosks, summer houses, etc., while on an elevated terrace stands the elegant Main Hall, along the south side of which are arranged on each side of the walk a magnificent collection of orange and lemon trees in bearing, and some of the finest specimens of the American agave or century plant ever exhibited. These have mostly been loaned to the exhibition by Messrs. Joseph S. Lovering, Allen Cuthbert, Charles Abbott, William Weightman and Alfred Cope, of Philadelphia, and Jos. Dunn, of Shadeland, Delaware County. There are also several fig-trees full of fruit.

Standing alongside the steps leading to the eastern entrance to the Hall is a fine specimen of sugar cane from the plantation of Joaquin M. Delgado, San Domingo. The cane is planted in a hogshead full of earth and is growing finely, each of the canes being over an inch and a half in diameter. Near by are two very handsome specimens of the mandarin orange plant from Juan Poey, of Havana, Cuba.

In the space lying between the northeast corner of Horticultural Hall and Lauber's Restaurant, P. Van-ness Azn, of Boskoop, Netherlands, has a fine exhibit of hollies, rhododendrons, roses, magnolias, and similar plants popular in European gardening.

W. C. Boer, of the same place, has a similar display, some of the plants being remarkably fine.

J. P. K. Galesloot, of Holland, exhibits the espalier system of training fruit trees against walls or upon trellises. He has a number of very fine dwarf fruit trees, trained in various forms on small trellises.

E. H. Krelage, of Haarlem, Holland, exhibits specimens of encomis regia in bloom; this is a bulbous plant, with leaves somewhat resembling those of a hyacinth and a tuft of feathery greenish white flowers. The same exhibitor has sent from Holland, and planted a bed of the common yellow milkweed, such as grows wild everywhere almost in the United States, but which in that country is carefully raised as a rare plant. The same exhibitor also has a bed of ranunculus and anemones, which cannot stand the climate and are dying out. He has also a large bed of crimson gladioli, and another of hyacinthus candidus, both in fine condition.

Albert Kuhn, of Weehawken, N. J., agent for Charles Pohl, of Austria, exhibits specimens of currants and gooseberries, grafted on the native Missouri currant bush, and grafted very high from the ground. They seem to be entirely free from the mildew, which almost entirely prevents the raising of foreign gooseberries here. This system is considered of much importance by nurserymen, as the foreign gooseberries are much finer than those raised in this country, and their general introduction is highly desirable.

Messrs. Soupert & Notting, of Luxembourg, France, exhibit a magnificent bed of roses, showing over 1200 different plants, and nearly all of different varieties. On the opposite side or southeast of the building, M. Eugene Verdier, of Paris, exhibits a bed of gladioli, showing nearly a thousand varieties. This bed and a similar one by M. Chas. Verdier, of Paris, a brother of the exhibitor first mentioned, contain the finest specimens of gladiolus in the exhibition, many of the varieties being new and remarkable for the size, shape and brilliancy of color of the flowers. Among the most noticeable varieties in M. Eugene Verdier's display may be mentioned the "Leandre," a very rich purple; the "Sirene," a delicate variegated pink; the "Merveille," a rich variegated crimson; the "Marie Stuart," white delicately touched with pink; the "Madame Desjartes," white, with a purple shade deep in the centre; the "Horace," of very fine shape and bright red color, and the "Solfatare," a beautiful soft yellow. In M. Charles Verdier's collection may be mentioned as noticeable the "Virginalis," white, with crimson edges; the "Ostrée," a large white flower marked with sharply defined purple spots; "L'Unique Violé," a large delicate purple flower, and the "Madame Sasseville," a rich salmon color.

M. Charles Verdier also exhibits a fine bed of roses, the stems of the plants being wrapped in moss to about two feet above the ground, the growth and bloom being entirely at the top of the plant.

Jean Sisley, of France, exhibits a bed of very handsome geraniums.

François Lachaume, of Paris, exhibits a large bed of roses, all of which are new varieties, originated by himself.

Juan Poey, of Havana, exhibits in a bed on the south side of the hall a very large growing specimen of the Yam vine. It is trained upon a trellis, and is about 12 feet high.

Jules Lachaume, of Havana, has a small rustic building erected south of Horticultural Hall. Around the exterior of this he exhibits a very rare and valuable collection of cacti, agaves and palms of several varieties. Many of the plants are of unusual size and great value. Inside the building he exhibits a collection of seeds of tropical plants; also specimens of fibre obtained from the leaves of the agave and other cacti, and ropes and twine made from the fibre, which is very strong and elastic. He also exhibits a specimen of a new Australian edible spinach, the growing plant being several feet long, and the leaves measuring three inches and more across.

Near by this exhibit stand a number of tents for garden use, exhibited by a French firm, and also a specimen of a galvanized iron cemetery enclosure, exhibited by Hanson & Petit, of Philadelphia.

Near the southwest corner of Horticultural Hall Mr. Robert Buist, of Philadelphia, exhibits a collection of ornamental trees and shrubs, mostly evergreens, and belonging to the coniferæ. They are well massed together and present a very effective appearance. The same exhibitor has also a bed of flowering shrubs in fine condition, among them a beautiful coral plant in bloom, and also a new species of Veronica with a delicate feathery blue flower. He has also a very handsome bed of roses of many varieties.

Messrs. Miller & Hayes, of Mount Airy, Philadelphia, adjoin Mr. Buist to the southwest. They have a very large and flourishing collection of ornamental trees and shrubs. Among the most noticeable are the Indian cedar, identical with the tree from which the indestructible timber used in the ancient temples of Delhi and other Indian cities is obtained, the remarkable skeleton-like Norfolk Island pine, the cedar of Lebanon, and a new hydrangea from Japan, valuable from the fact of its being in bloom when but few other shrubs are flowering. The same exhibitors also have a large circular bed, mound-shaped and planted in bands of various colored coleus, cannas, pampas grasses, variegated bamboos, etc. They have also a fine rose bed, with over three hundred varieties of roses.

Messrs. Hoopes Brothers and Thomas, of West Chester, Pa., have a collection of forty different kinds of ivies, trained on flat trellises of wood and wire. It gives an excellent chance to note the merits of the various kinds. Among the new forms is a delicate and beautiful one called "conglomerata," but the inexpert beholder would not suppose it to be an ivy at all. The same firm have also a collection of coniferous evergreens, among which are many new varieties recently introduced from Japan.

Mr. Thomas J. Mackenzie, of Philadelphia, has a small circular bed immediately adjoining the south side of the sunken parterre. It is planted with plants of coleus, geraniums, canna, etc., and has in the centre a fine sago palm.

Messrs. R. B. Parsons & Co., of Flushing, N. Y., have an excellent collection, mostly of rhododendrons and other evergreens. The rhododendrons are admirable specimens. There is a very handsome specimen of the picea Nordmanniana, considered among the best of all firs for ornamental purposes.

Messrs. S. B. Parsons & Sons, of Flushing, N. Y. (another firm), have also some fine rhododendrons, and also a special bed for Japanese plants selected in Japan by Mr. Hogg, a well-known collector, and imported direct. They are principally coniferæ, but there are many varieties of the Japan maple; there is also a very curious maple with leaves like a hornbeam, and named "acer carpinifolia." It seems somewhat allied to the well-known Tartarian maple, and will no doubt serve the same purposes in landscape gardening. There is also the variegated planera japonica and the Daphne Gwenkwa, a light blue flower, which promises to become a popular hardy early flowering shrub. In the general collection of rare plants by these exhibitors are the blo d-leaved Norway maple and a beautiful purple-leaved Daphne mezereon.

Mr. Thomas Meehan, of Germantown, has a large bed, neatly bordered with white artemisia, containing specimens of over 750 varieties of shade, ornamental and timber trees, of almost every kind known in the United States and many from foreign countries. Out of the 23 varieties of oaks that are indigenous to America, Mr. Meehan has specimens of 20 varieties, and other trees in proportion.

Messrs. Asher Hance & Son, of Red Bank, New Jersey, have a small collection, with some very fine plants, noticeably a very handsome specimen of the Japan sumach. There is also a good specimen of the blood-leaved birch tree and weeping yellow elm.

The Messrs. Veitch, of England, exhibit a choice collection of plants, which have been presented to the Park Commissioners. Some are too tender for our climate, without protection, and a few have already died. There some fine rhododendrons; the umbrella Japan pine, a remarkably beautiful and very hardy evergreen, but slow in growth when young; a number of rare pines and hemlocks, and several rare hollies, some of which are trimmed into fantastical forms.

Mr. Peter Henderson, of New York, exhibits one hundred varieties of geraniums in one bed, and in another circular bed some beautifully arranged coleus, with a centre of caladium and Indian shot.

Gabriel Marg, of Woodside, Long Island, exhibits in a small bed a fine collection of standard tree roses.

William F. Boyle, of Philadelphia, exhibits a number of small geraniums and coleus.

Robert Scott, of Philadelphia, has a large bed with many varieties of geraniums, and also a fine collection of roses.

August Boileau, of New York, exhibits a fine collection of dwarf fruit trees, trimmed and trained espalier fashion.

Mr. Siebrecht, of New York, exhibits a specimen of rock work.

William C. Wilson, of Astoria, L. I., exhibits a fine display of coleus, cannas, and other ornamental plants, set out in ribbons of various colors.

Gibson & Bennett, of West Jersey, exhibit verbenas and lantana in great variety.

Christian Zeller, of Flatbush, L. I., exhibits a bed of pinks and carnations, which seem to have passed the height of their bloom.

All the exhibits mentioned above are on the south side of the sunken parterre in front of Horticultural Hall, and have been mentioned almost in their order, commencing at the Hall and coming westward towards Belmont avenue.

On the opposite side, commencing on Belmont avenue and working back towards the hall, we come first to a very fine exhibit of geraniums, petunias, lobelias, etc., by John Dick, of Philadelphia. They occupy three large plots and present a very attractive appearance.

George Such, of South Amboy, N. Y., exhibits a splendid collection of palms, agaves, New Zealand flax, bananas, etc., also a very fine specimen of the Egyptian papyrus. The agave plants in this collection are unusually good, and many of them are valued at $100 a piece and over.

The Pacific Guano Company, of Boston, have one of the most interesting exhibits on the ground. For a long time it was a question how to make a guano exhibit attractive, but they have overcome the difficulty by showing the effects of their fertilizer on plants in growth. They have a handsome octagonal pavilion, Oriental in architecture and decoration. It is surrounded at the base by steps leading to a broad platform, on which are arranged tropical plants, bananas, sago palms, cotton, sugar cane, ferns, etc., and seats for visitors. Inside are shelves containing specimens of the materials entering into the manufacture of the guano, and a set of glass jars, in which are exhibited the materials in the various stages of preparation. In the centre is placed a large octagonal case, containing a fine collection of fossils taken from the phosphate beds of South Carolina.

In a marquee on the grounds are also to be seen models of the company's works at Chisolm Island, South Carolina; Charleston, South Carolina, and Wood's Hole, Mass. Surrounding these buildings are a number of large beds, containing tobacco, sugar cane, cotton, both Sea Island and upland, castor beans, broom corn, sorghum, rice, etc., all in full growth and thriving beautifully. The cotton is now opening out the bolls finely. The rice is planted in tubs set in the ground, and several inches of water are kept standing in the tubs over the roots of the plants. There is also a display of flowers and ornamental foliage plants, including some choice and beautiful ornamental beets and fine tuberoses.

A. L. Felten, of Philadelphia, exhibits a collection of dahlias and ornamental gourd vines in full bearing.

Peter Henderson, of New York, has a very handsome circular bed planted with ribbons of coleus, geraniums, etc., with large plants in the centre.

Mahlon Moon & Son, of Morrisville, Pa., have a fine display of evergreens, rhododendrons, pines, etc., also some very good gladioli and a new species of morning glory.

Thomas J. Maginly, of Philadelphia, exhibits roses, geraniums, coleus, etc. Among the roses are some very handsome and new varieties.

Henry A. Dreer, of Philadelphia, has two large plots planted in gladioli, verbenas, petunias, etc., very brilliant in color, and presenting an extremely attractive appearance. He has also some very fine ornamental beets.

W. K. Harris, of Philadelphia, has three beds of geraniums of many different varieties.

Thomas Robertson, of Philadelphia, has a very fine bed of coleus, planted in ornamental forms.

O'Brien Brothers, of Yonkers, New York, have an unusually fine display of rustic work, summer-houses, garden-chairs, etc.

The Phœnix Stone Manufacturing Company exhibit a pavement of their artificial stone, and the Lebanon Building and Paving Block Company a pavement of tiles made from blast-furnace slag.

M. Walker & Sons, of Philadelphia, exhibit specimens of rustic wire work, trellises, summer-houses, etc.

The large tent in which the rhododendrons were recently exhibited in bloom is now being prepared for the flower show to take place next month; sodded banks are being thrown up to take the place of tables.

The Chief of the Bureau of Horticulture is Mr. Charles H. Miller, of Mount Airy, Philadelphia, under whose control the grounds have been laid out, and who has charge of this portion of the exhibition.—*Philadelphia Ledger.*

THE CHEMICAL INDUSTRY OF GERMANY AT THE CENTENNIAL.

BY THE COMMITTEE OF THE ASSOCIATED GERMAN CHEMICAL MANUFACTURERS.

I. Technical-chemical and pharmaceutical-chemical substances and fertilizing agents.

This class comprises the more prominent branches of the chemical major industry.

Leblanc's soda process, in spite of the many not unimportant researches concerning it, has, chemically speaking, experienced no important modification. In the construction of the ovens employed, however, an improvement has been effected—the principle so much applied in iron technology, of a revolving oven, having here found application. Of the many proposed new methods for the transposition of the salt into soda, only the so-called ammonia soda process has been able to procure itself an introduction into chemical industry. In spite of all doubt concerning the profitableness of the method, it is a fact that at the present moment the soda so produced can, as excellent 98 per cent article, compete with the Leblanc soda.

But seldom do statistics reveal to us such a great success and such a profound revolution of an industry as the utilization of the Stassfurt and Leopold Hall waste salts have occasioned in the potash industry. Although an offspring of most modern date—hardly ten years old—the decomposition and utilization of these salts have as well as superseded all other methods of producing potash salts.

Corresponding to this colossal production, there are employed in this branch of industry, besides 1100 miners in the two mines, on the average 3000 workmen.

In 1872 were produced:

Potassium chloride in various degrees of strength, 80 per cent, 90 per cent, 95 per cent and 98 per cent, about 132,000,000 lbs.

Potassium sulphate, by double decomposition of potassium chloride and magnesium sulphate, about 2,750,000 lbs.; Potassium carbonate (potashes) about the same amount. Magnesium sulphate, raw and crystallized, about 22,000,000 lbs. Sodium sulphate, crystallized and calcined, about 13,300,000 lbs. Magnesium chloride, crystallized and fused, about 11,000,000 lbs. Boracic acid, about 26,400 lbs. Bromine and bromine preparations, about 77,000 lbs. Artificial bath-salts, about 220,000 lbs. Potash manures, in various grades, about 110,000,000 lbs.

A not inconsiderable part in the increase of the Stassfurt and Leopold Hall industry is taken by the utilization of the potash salts as manures.

About 30 per cent of the total production of the Stassfurt industry is consumed at home, while about 70 per cent is exported especially to England, France, Belgium, and the United States, etc.—a striking proof of the importance of this branch of industry for foreign countries.

While not twenty years ago the entire amount of potashes coming into commerce was made from the ashes of plants containing potash—whole forests falling martyrs to this mode of production—we are now indebted to the disclosure of the Stassfurt potash industry for a new and advantageous process of manufacturing the potassium carbonate, so necessary in many branches of industry. This process, as already mentioned, seems qualified to place all other methods in the background, and the more so as the potashes won from potassium sulphate, and containing 92 per cent of pure salt, are by far purer than all other potashes which come in the market. Of the 105,600,000 lbs. total produce, 55,000,000 lbs. are made from potassium sulphate.

A considerable part of the hydrochloric acid appearing as by-product in Leblanc's soda process is used in the preparation of chlorine, which, as chloride of lime, is brought to a solid form, or is utilized in the manufacturing of potassium chlorate. While the home production of chloride of lime has not become equal to the English, and considerable amounts are yet imported, the manufacture of chlorate of potash is of equal birth, and is not only able to compete with the English product, but has, far more, as well as superseded it.

The utilization of the manganese lyes naturally plays an extraordinarily important rôle in the profitableness of the chlorine products, and it can not be denied that Germany is somewhat behind other countries in that respect. The Weldon method used for this purpose (precipitation of neutralized manganese lyes by lime, and oxidation of the obtained pap by pressing air through it) is very generally extended in England, while in Germany but few manufacturers have adopted it. In a similar manner, although from another point of view, the Deacon process, dispensing entirely with the use of manganite, and depending chiefly on the decomposition of copper oxychloride at a high temperature by leading steam, air and hydrochloric acid over it, has, as yet, found no important introduction into Germany.

The bromine production at Stassfurt has suffered a sensible injury by the large importation of American bromine into Germany, and can only with difficulty be restored to its former importance.

The chief source of the ammonia production, which is worked up as aqueous solution, as well as sulphate, carbonate and chloride, is the ammoniacal water of the gas works. The sulphate has already procured itself an introduction as a manure, while a greater demand for caustic ammonia and the carbonate, occasioned by the influence of many new branches of industry, as, for example, the Carré ammonia soda method of manufacturing ice, is to be predicted.

While formerly only the native sulphur formed the raw material for the production of sulphuric acid, to be later superseded by pyrites, we see to-day a whole series of other materials being utilized in the manufacture of sulphuric acid. The great majority of the larger metallurgical works, yielding to the force of circumstances, and, in most cases, to the influence of boards of health, have taken up the utilization of the sulphurous acid formerly escaping in enormous quantities into the air. The residues from the Laming mixture of the gas works, containing large amounts of sulphur, and the sulphur obtained from the soda residues, are also utilized with advantage in the manufacture of sulphuric acid. The ordinary pyrites ovens being utterly inapplicable to the burning of these substances, it has been sought to construct suitable ovens for this purpose, and it is especially in this field that German technologists have introduced important improvements.

The introduction of the Glover-tower, first used in England, into the German sulphuric-acid manufacture, marks a further progress. The use of the same allows not only of a greater saving in the employment of nitric acid, but renders it possible to apply the heat of the hot sulphurous acid from the washing-ovens to the concentration of the sulphuric acid.

From the remaining chemical-technological products of the major industry, there remain to be mentioned nitric acid, yellow prussiate of potash, alum, aluminium sulphate, acetic acid, and oxalic acid.

The nitric acid has found increased application by its use in the manufacture of aniline and alizarine colors, as well as by the increased production of sulphuric acid, nitro-glycerine, and gun cotton. Of the salts of this acid, the potassium compound is by far the most important. It is made in Germany almost entirely by the decomposition of sodium nitrate with potassium chloride.

The yellow prussiate of potash, the starting-point of the other cyanogen compounds, finds manifold application as such in the production of blue colors, or in the form of potassium cyanide, in the most various branches of industry. The use of Berlin blue having become, however, confined, the manufacture of the yellow prussiate of potash, in Germany especially, since animal refuse, owing to the increased demand for manures, has risen in price, has made but little progress. The many attempts to produce the nitrogen of the cyanogen compounds from other than animal sources have as yet not given results of practical value.

The manufacture of alum and aluminium sulphate, which have an extended application in dyeing, cloth-printing, and tawing, as well as in paper-making, has remained as well as unchanged, except that ammonia has been substituted in the alum in place of the potash.

Oxalic acid, which a few years ago was almost entirely an English monopoly, has lately become the object of an extended manufacture in Germany. The oxalic acid produced in Germany leaves nothing to be desired as regards its quality, and can confidently compete with the English product.

The oxidation of alcohol on the one side and the distillation of wood on the other remain the methods for the wholesale manufacture of acetic acid and the many salts of it, finding application in technology.

For the production of lead acetate, the acetic acid from alcohol is used almost exclusively, as the latter, when intended for this branch of industry, enjoys indemnity from duty, and hence, without difficulty, can compete with the pyroligneous acid. It is different, however, with the other acetic-acid preparations, in whose production the alcohol employed is not free from duty. The present unusually low price of alcohol alone renders it possible to maintain a competition with the acetic-acid products made from pyroligneous acid.

The large portion of pyroligneous acid is indebted to the very important extension of the industries connected with the distillation of wood. The large consumption of methyl-alcohol by the aniline-color works, and the constantly increasing demands for acetic acid and its salts by the technical industries, have occasioned the utilization of the relatively large forests of Germany to appear all at once so very profitable in this respect that such works have sprung up like mushrooms. On account of the decrease in aniline-color production, the demand causing an excessive production has weakened, so that this branch of industry at the present moment suffers severely. This is shown especially in the case of acetic acid by its unprecedented fall in price.

We may calculate the production of 100 per cent methyl-alcohol in the years 1872 and 1873 as at least 1,320,000 to 1,540,000 lbs. per year, corresponding to about 5,280,000 lbs. of 100 per cent pyroligneous acid; certainly a large quantity, and which, in conjunction with the acetic acid produced from alcohol, far exceeds the demands of Germany.

Apart from the productions of the proper chemical major industry lies the manufacture of a great number of pharmaceutical-technological and scientific-chemical substances, which we can not properly pass by in silence, since it is especially this manufacture which has been brought to a high degree of perfection in Germany. This agrees particularly with the considerations already introduced at the beginning, that the high perfection which the study of chemistry in general has attained in Germany has made this branch of industry, demanding relatively the largest amount of chemical knowledge, capable of competing with any of the foreign manufactures.

Concerning the extent of their production, the amount is far outweighed by the value of the products, so that a not inconsiderable number of them, as respects their sale, may be classed among the products of the chemical major industry. From the field of inorganic chemistry, we shall only refer to those of the great number of acids and salts which are used in pharmacy.

The dyeing, printing, galvano-plastic, and pyrotechnical establishments—in short, a large number of technological industries—make the discoveries of science useful to their purposes, and even of the rare metals but few can be named which as such, or as some of their compounds, find no application in technology. To see their way in this enormous labyrinth, to have a knowledge of the wants of the day, to keep an open eye and ear for every novelty, is the task of these establishments. Owing to the daily increasing material, divisions have taken place within the chemical minor industry. The organic has not only separated itself from the inorganic, but is itself split asunder in all directions.

In regard to the field of organic chemistry, the front place is held by manufactories producing alkaloids. The difficulty of overlooking the drug market, combined with the extraordinary variations in price, according to the results of the harvest of many drugs, as opium, cinchona, etc., make a careful observance of the market a necessary condition, and hence it was in this department that a division of labor was first perfected.

We find in Germany a whole series of manufactories occupied exclusively with the production of alkaloids. Unfortunately, the statistical material at our disposal is unserviceable in judging of the value and extent of the total production, so that we must confine ourselves to referring to this deficiency.

The manufacture of alcohol preparations, more particularly of ether, acetic ether, and absolute alcohol, is confined to a few of the larger manufactories, since the difficulties of transportation of these liquids, and, furthermore, the burdens of duty, render an extended export impossible. From its great production of alcohol, hardly any other country can compare with Germany in the production of these articles.

Indirectly connected with these preparations are fruit-ethers, chloroform, chloral-hydrate, tannin, pyrogallic acid, iodoform, etc., with which products Germany supplies Russia, France, England, and the United States.

The consumption of chloral-hydrate, which promised to become an article produced on a large scale, does not appear to increase. The export of the substance is, however, considerable.

Potassium, iodide, and bromide, although their manufacture in foreign countries is not inconsiderable, may be mentioned as export articles.

A specifically German industry is the production for science of important and interesting chemical preparations, particularly in the domain of organic chemistry. The Exhibition gives an agreeable picture of the progress in this field. Even although the pecuniary results, owing to the small demand, can be but small, yet they are well calculated to obtain in foreign lands a good name for German knowledge and wealth. The bond of sympathy which unites these establishments with science and its followers, bears the latest chemical acquisitions to the remotest regions, and gives the proper guidance to their technical utilization.

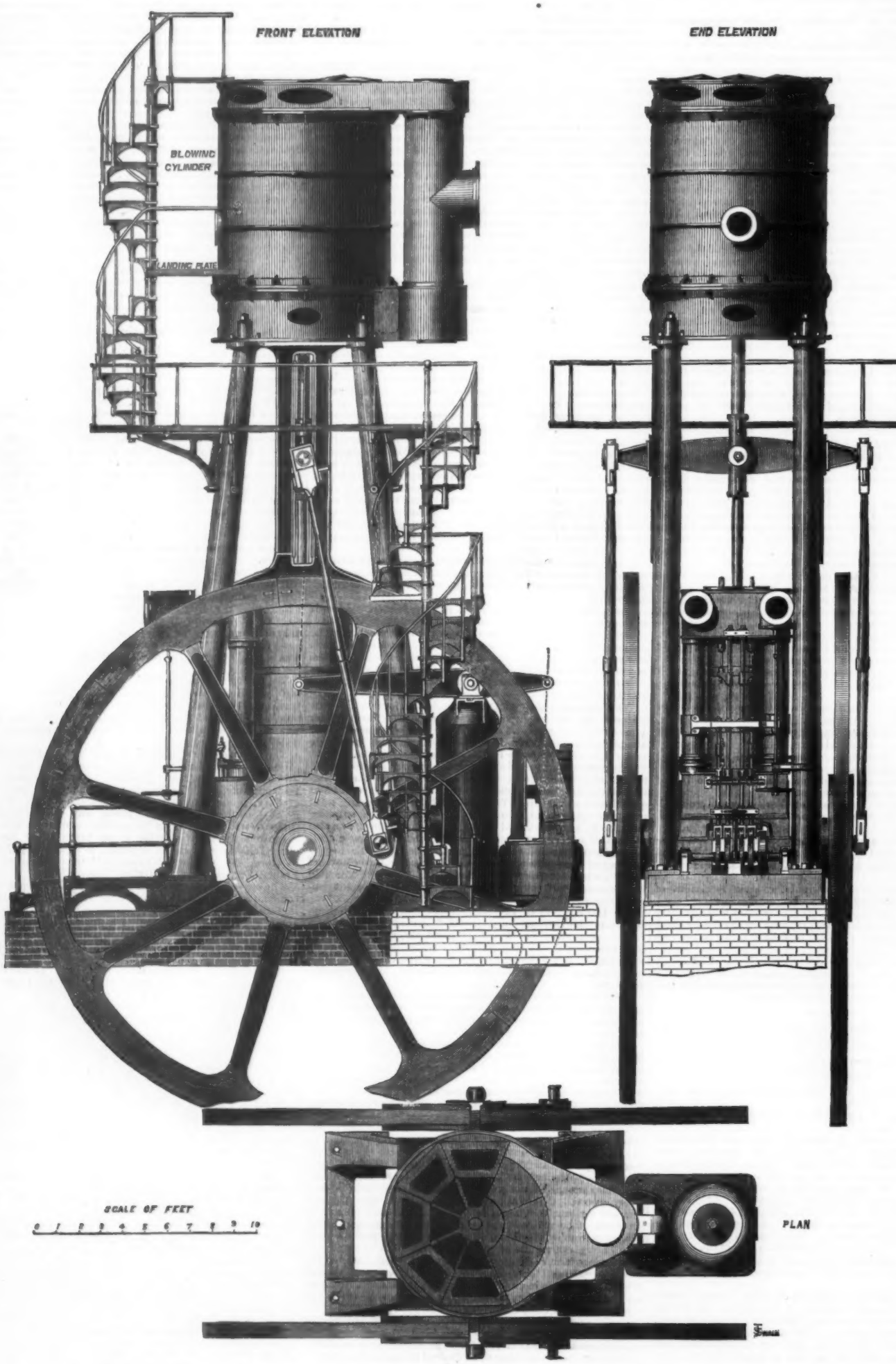
Salicylic acid and its derivatives, and vanillin, are striking examples of the above. The first, an ordinary organic acid extracted from the gaultheria oil (wintergreen), attracted no attention so long as its price corresponded to the expensiveness of the raw material. Since a convenient method of preparation from carbolic acid has been invented, however, it has become the object of a lively manufacture, and its applications increase with the ease of its production.

Artificial vanillin, which hardly a year ago first became known in chemical circles, is now in great demand as a substitute for the natural vanilla. While until then, we obtained the vanilla aroma from tropical countries, we are now able to produce it in any quantity from the pine forests.

In the manufacture of essential oils, also, the endeavor is made to emancipate ourselves more and more from the silent operations of the plant, and to utilize materials more conveniently to be obtained. As examples, may be mentioned the gaultheria oil, the bitter ammond oil, the mustard oil, and the latest of all, the oil of the Spiræa Ulmaria, the salicylic aldehyd. Owing to the cost of the materials for research, it is but natural that advance in this path is somewhat restrained, but it is not to be doubted that eventually a large part of the essential oils will be produced by synthesis.

THE INTERNATIONAL EXHIBITION OF 1876.

BAYARD TAYLOR, the eminent traveller and writer, who has been a careful observer and attendant of all the great exhibitions throughout the world for the past twenty-five years, says of the display at Philadelphia, "Taken as a whole, the Exhibition surpasses all its predecessors in beauty of position, convenience of arrangement, and variety of interest."



THE INTERNATIONAL EXHIBITION OF 1876.—THE J. P. MORRIS BLOWING ENGINE.

CAMPHOR AT THE EXHIBITION.

MORE limited in the countries of production is camphor, which is furnished by the laurel Camphora officinarum, Bauh., a stately tree of Japan and the eastern portion of Asia, where it is obtained by subjecting the cut branches and wood to a crude distillation in the presence of water; after draining it in vessels having a perforated bottom, it is met with in the market as Chinese and Japanese camphor, which varieties are exhibited in their proper departments. The former, or Formosa camphor, is usually of a light-brown or gray color; the latter is nearly white, or somewhat pinkish, and both occur in their crude state in the form of small grains. The refining of the crude article appears to be carried on in Europe still in peculiar-shaped glass flasks, which require to be broken in order to obtain the cake of sublimed camphor. Of late years the refining of camphor has become quite an industry in the United States, where it is effected in vessels constructed for the purpose, having a movable lid, upon which the sublimate condenses; with this arrangement the expense of a glass vessel for each cake is saved.

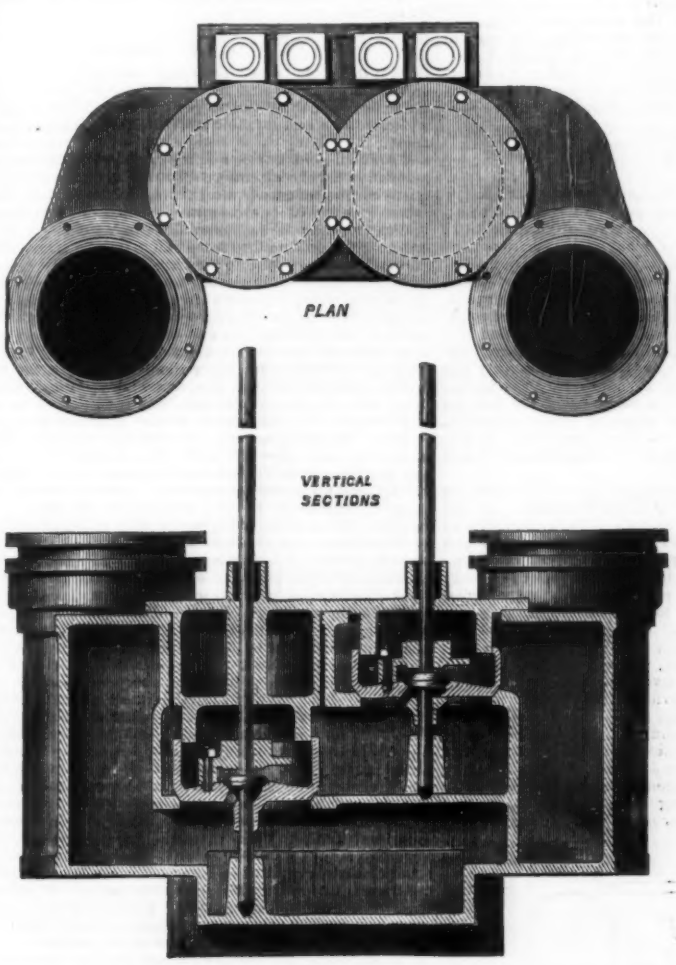
Crude camphor is exhibited by China and Japan as one of their staple articles, and in the department of the latter country is also found some refined camphor in large fragments, apparently broken from larger cakes. Circular cakes of the refined article, with the accustomed circular hole in the centre, are exhibited by Chas. Pfizer & Co., of New-York, and Kurlbaum & Co., of Philadelphia, the last-named firm collecting also the volatile oil with which the crude camphor is always more or less impregnated, and which is lost in the old method of purification; like the Formosa oil of camphor, with which it is identical, it contains variable quantities of camphor in solution.

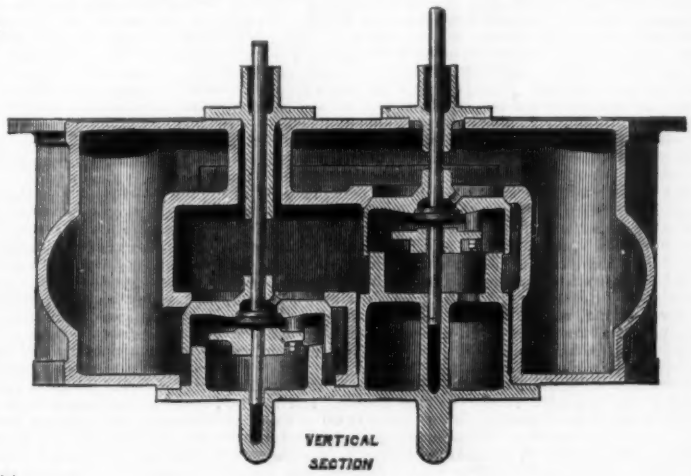
Camphor, as is well known, is extensively employed for protecting clothes from the ravages of moths; the crystalline cakes, in which it is usually met with, contain many fissures, from which the volatilization of the camphor proceeds, the same as from the surface. It is obvious, that with a decrease of the entire space presented to the air, the rapidity of evaporation must necessarily be lessened, while its effectiveness must remain the same if, through the slower evaporation, the confined atmosphere may still be kept saturated with camphor. This idea is carried out in the compressed camphor, manufactured and exhibited by W. F. Simes & Son. This firm distil crude Japanese camphor slowly from a suitable retort, and carry the vapors into a large chamber, where it condenses in the form of a very fine crystalline powder, which is afterwards compressed by hydraulic pressure into rectangular blocks of a definite weight. These blocks may also be made directly from the crude camphor, and then contain also the small percentage of impurities naturally found therein.

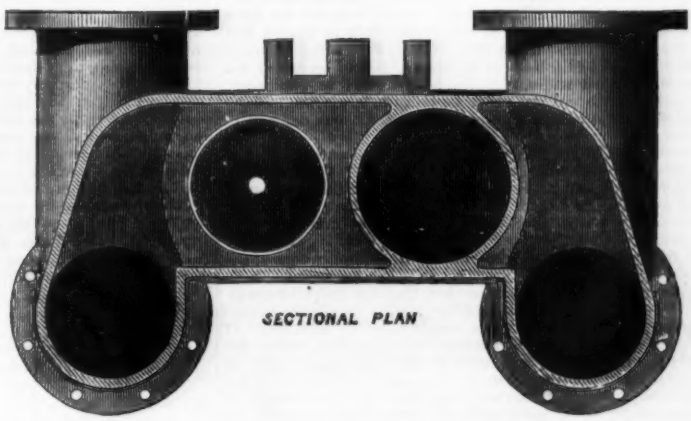
Among the chemical derivatives of camphor we notice crystallized camphoric acid, in the interesting and instructive exhibit of H. Trommsdorff, Erfurt, and monobromated camphor, by most of the manufacturers of medicinal chemicals of the United States, Germany, and some other countries. If we are permitted to judge from the number of exhibitors in the various departments, and from the quantities exhibited, this compound has everywhere rapidly gained the confidence of physicians, and become an important remedy since it was first recommended by Prof. Deneffe, a few years ago. Although all the samples on exhibition are evidently pure and nicely crystallized, yet, in our opinion, decidedly the handsomest and largest crystals are shown by Hance Bros. & White, Philadelphia, who have on exhibition 38 lbs. of this compound, the result of one crystallization. We are informed that this firm employ essentially the process published in this journal, 1872, p. 342, allowing the heat to rise to 270° F. (132° C.) and even 280° F. (138° C.), and that other processes, which were published more recently, did not yield such favorable results. These observations, made on a large scale, coincide, therefore, with the experiment of F. C. Linthicum (see August number, p. 346). The crop of crystals exhibited by the firm mentioned was obtained from petroleum benzin. —*Amer. Jour. of Pharmacy.*

THE LARGEST ENGINE IN THE EXHIBITION.—THE J. P. MORRIS BLOWING ENGINE.

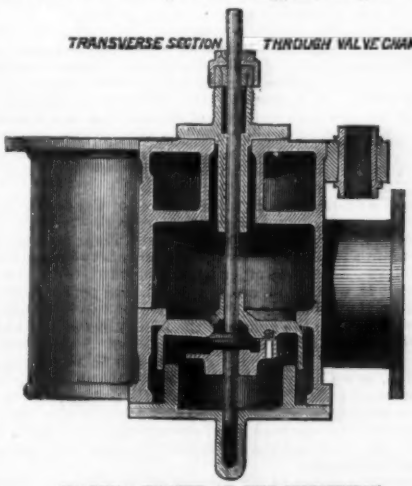
OUR drawings show the largest engine in the Exhibition. They represent the blowing engine exhibited by the J. P. Morris Company, which is constructed after a style now much in favor with many American furnace managers. In its design the following points were sought to be obtained: Compactness, without sacrifice of accessibility to moving parts; self-adjustment of parts liable to inequalities of wear; steadiness of the whole structure, and preservation of alignment by being self-contained. All the parts are proportioned to the work of supplying blast of 10 lbs. pressure steadily, if needed; and though the ordinary working of anthracite coal-burning furnaces does not demand that high pressure, it has been exceeded in one case, 13½ lbs. having been blown off for a considerable period of time without damage to the engine. The Wanich equilibrium valve with which this engine is fitted was applied first about four years ago to an engine at the Lebanon Furnaces, and soon after it was applied to a second engine at the same furnaces, on both of which it has proved highly satisfactory, saving steam and being entirely manageable. Double-beat valves will leak even if ground in, under steam, owing to unequal expansion between themselves and the chamber containing their seats. The single-beat valve with a "pilot" or supplementary valve is not easily handled on blast engines, where it is found best, in order to promote regularity of motion, to set the steam valves late, sometimes so much that the piston has moved one-twelfth of its stroke before steam is admitted; consequently the passages and space within the cylinder to be filled are proportionately so great and rapidly increasing that steam cannot pass by the pilot valve fast enough to equalize the pressure on the upper and under sides of the main valve unless the pilot valve be increased largely in area, when it becomes unmanageable by hand. To overcome this, Mr. Wanich, foreman of the machine shop of the J. P. Morris Company, designed the valve illustrated, and found its action to realize what was anticipated of it. It consists in the use of a ring cast on the back of the main valve, extending upward, and bored out so as to envelop and slide freely upon the outside of another ring cast on the steam-chest bonnet, dropping downward and turned off. The rings are, of course, concentric, and the annular space between them is quite small in area, very much less than the aggregate area of the holes for the passage of steam below the pilot valve; consequently, any steam passing the annular opening when the pilot is raised goes freely through into the cylinder, exerting no appreciable pressure on the back of the main valve, and permitting it to rise easily. This absence of pressure has been proved by connecting with the space inclosed by the rings an ordinary steam gauge, which showed the pressure when the pilot was seated to be, say, 35 lbs., and when the pilot was raised the pressure suddenly fell to almost zero until the main valve opened, when it rose again to 35 lbs. The blast valves are of selected thick sole leather backed with plate iron; blast piston fitted for either metal, wood, or bag packing; steam piston fitted with metal double rings held out by springs; valves are lifted by cams operating directly against rollers fitted into the bottom ends of the lifting rods. The cams are adjustable, but not variable, and give facilities for experimenting to determine the best distribution of steam without interference with each other. The cam shaft is driven by spur gears fitted to main shaft. The fly-wheels are large, and weigh nearly 18 tons. The rim on the side in line with the crank pin is cored out, so that the preponderance of the opposite side will counterbalance weight of pistons, rods, crossheads, etc. Shafts are of wrought-iron with ample bearing surface. The crosshead swivels in the yoke connecting the two piston rods, and is provided with spherical journals for the connecting rods, so that it may accommodate itself to any inequalities of wear in the main shaft or crank pins. The height of the engine compared with its base is suggestive of instability, but that defect does not exist. A foundation of hard bricks or good stone, long and wide enough to take the bed plate, and 10 ft. deep, is known to be quite sufficient to sustain the engine without perceptible swaying of the top. This height is mainly due to length of stroke compared with diameter of blast cylinder, whereby a given quantity of air can be supplied by a lesser number of revolutions—usually in engines of this stroke not exceeding twenty—and with fewer beats of the blast valves; and as with fixed diameter of blast cylinder the loss in delivery due to piston clearance and space in the passages is a certain quantity, it is clear that the percentage of loss of useful effect from this cause diminishes as the stroke increases. The dimensions of the principal portions of the engine are as follows: Blowing cylinder, 90 in. diameter, 7 ft. stroke; steam cylinder, 50 in. diameter, 7 ft. stroke; two fly-wheels each 24 ft. diameter; bed plate, 13 ft. by 8 ft.; total height of engine, 36½ ft. Capacity, 10,000 cubic feet of air per minute.—*The Engineer.*







THE INTERNATIONAL EXHIBITION OF 1876.—THE J. P. MORRIS BLOWING ENGINE.



BLOWING ENGINE AT THE EXHIBITION.

IN Memorial Hall there are 22 Sèvres vases, all of modern manufacture, exhibited by the Government of France. These vases—in color, quality, and form—are the finest in the Exhibition.

ECONOMY OF FUEL IN ENGINES.

MR. W. GRAY HARBOWER, writing to the *Glasgow Herald*, says that a series of experiments have been brought to a temporary conclusion at Portsmouth, the results of which are of the highest interest to engineers and users of steam-power. The experiments were for the purpose of testing the economy of fuel effected by Mr. R. M. Marchant's invention for returning the "exhaust steam" of engines to the boiler, to which attention was recently called. The tests were conducted on a condensing-engine of 40-horse power in use at the Dockyard at Portsmouth, which had been submitted for the purpose of the experiments by the Admiralty authorities. To this engine had been affixed a set of Mr. Marchant's "Stage Process Steam-Pumps," the action of which in condensing-engines may be thus briefly explained: A double-acting pump takes off from the exhaust steam of the lower pressure cylinder the same volume of steam as is admitted into the high pressure cylinder at each stroke. This steam is received by a reservoir above the pump, and is then forced by one stroke of a similar double-acting steam-pump into a reservoir of half the size. By the second stroke of this pump the steam is again compressed by half its volume, and forced back into the boiler. The steam is saturated with boiling water during its passage through the pumps, and it is therefore returned to the boiler in the form of vapor. All heating of the pumps, which would be incurred were the steam returned in its normal state, is thus avoided.

The trials which have been made at intervals, as opportunity occurred during the past week or two, were conducted under unfavorable conditions, which largely affected the result; but, notwithstanding, these have given the highest satisfaction. On the 24th ult. the engine was run for six hours as an ordinary engine, without the patent steam-pump attachment, during which time the expenditure of 1176 lbs. of coal gave a mean indicated horse-power of 85.747. On the following day the engine was run for the same number of hours, with the steam-pump attachment in action, when the expenditure of 1158 lbs. of coal resulted in a mean indicated horse-power of 104.123. Thus, with 18 lbs. less expenditure of fuel, an increase of power was effected to the extent of 20 per cent. The power expended to work the steam-pumps at 120 revolutions had been previously ascertained by friction cards to be six indicated horse-power. This trial may therefore be said to indicate an effected economy by the use of the pumps of over 20 per cent of fuel. This being the first attempt on Mr. Marchant's part to affix his apparatus to an engine other than his own experimental engines, the application was, of necessity, not perfect. Apart from the unfavorable conditions which, in the opinion of competent judges, greatly detracted from the value of the results attained, it was found that, in consequence of information supplied to him, the inventor had made a serious miscalculation in regard to the capacity of the pumps. These were calculated and constructed for a boiler pressure of 100 lbs., but permission was only given to work at 70 lbs.

When this is rectified, and the pumps are of the required capacity, the indicated results will be doubled, and the inventor is confident of attaining an economy of 50 per cent of fuel. A tabular statement of the results of the trial is in preparation. While Mr. Marchant's invention is applicable to any engine (either condensing or high pressure) with an ordinary boiler, its perfect application requires a boiler of special construction. This boiler is of much smaller dimensions than usual—is of tubular construction; and, in view of the recent terrible accident on board the "Thunderer," this and the whole invention assumes an importance beyond that of its mere economy of fuel, inasmuch as its adoption will in future render such calamities impossible. The boiler being of small dimensions, and in tubes, can be constructed to resist any degree of pressure, while, if it should give way at any point, the consequence would simply be that the steam would blow off at that point as if from a safety-valve, without damage to any one.

A set of Mr. Marchant's patent pumps had been affixed a few weeks since to the engines of the steamship "Thames," but an accident consequent on the giving way of a stud prevented their use, and the vessel had to proceed to sea without the use of its expansion gear. During the brief time, however, which the pumps were in use their action gave every satisfaction. Both these experiments were applications of the invention to existing engines; but it is in new engines, with lines of the required construction, that the inventor anticipates attaining the highest possible results in effecting economy of fuel. Every one can understand the advantage of supplying the boiler with boiling water, thereby saving the cost of boiling it. It is admitted that the manufacture of steam without pressure costs, in the best application, 75 per cent of expended fuel, and it is argued that as the supply of boiling water to the boiler saves the cost of boiling it, so the supply of steam to the boiler will save the greater part of the cost of manufacturing it. This the inventor appears to be in a fair way of accomplishing, and the most sceptical in regard to his invention now admit that his application of the exhaust steam will effect a saving of from 30 to 40 per cent of fuel.

RULES FOR CALCULATING THE POWER OF BELTING.

As the power of a steam-engine is expressed in three several ways—nominal, indicated, and actual—so the ability for a belt to transmit power may be expressed in three corresponding methods. We may denote, first, the possible power; that is, the power which it is possible for the belt to transmit under the very best conditions. The power which it is possible for a belt to transmit is simply on the strength of the belt and the peripheral velocity of the driving pulley. In taking power from any source of motion, these are the two points which control us; all the others we can control and modify to a certain extent. Moreover, we can determine these data with a considerable approach to accuracy; while all the others demand very difficult and careful special experiment. Seeing, then, that ordinary belts will, as we have stated in a previous article, sustain safely a working tension of 45 lbs. per inch in width, the rule to determine the width of belt and size of pulley required to transmit a given horse-power is easily found. Since a horse-power is 33,000 lbs. raised one foot high per minute, we must adjust the width and velocity of belt so as to effect the required result. Thus, if the belt moves with a velocity of 733 feet per minute, a belt five inches wide will transmit five horse-power, provided the effective tension is 45 lbs. per inch. If the velocity be increased to 1466 feet per minute, the same belt, with the same tension, will transmit ten horse-power. So that a five-inch belt, applied to a pulley four feet in diameter, making 120 revolutions per minute, would transmit ten horse-power when the effective tension is 225 lbs. We say effective tension, meaning thereby the tension actually applied to produce the revolution of the receiving pulley.

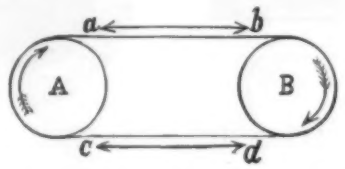
A belt may be subjected to great tension, and yet a very little of this tension may be applied to the transmission of power. But this circumstance can only arise when very little resistance is offered by the receiving pulley. If the latter offers an adequate resistance, the power will be transmitted. Consequently, the rule that we have indicated corresponds to the rule for determining the nominal horse-power of a steam-engine; the engine may work up to the power assigned to it, and indeed may in general far exceed this power; just as the belt may transmit the power for which it is calculated, though there is no certainty that it does so. By taking the actual effective tension of the belt, and multiplying it by the actual velocity, we get what may be called the indicated power of the belt, which corresponds to the indicated power of the steam-engine. And, finally, by measuring the actual power transmitted—which may be done by means of a dynamometer—we can get the actual power transmitted. Rules based upon the amount of belt surfaced in contact with the pulley, and on similar data, can not be made to give reliable results. For practical purposes, velocity and power to resist tension are the only available elements of the calculation. Actual tension, adhesion, friction, etc., can all be varied at will, and consequently form no certain dependence for the calculations of the machinist and engineer.

That the rule which we have given for calculating the nominal power of a belt is very nearly that which has been discovered by experience, irrespective of theory, and adopted in the practice of some of our best shops, may be verified by actual examination. In a large iron-works with which we are acquainted, the power of a 125 horse-power engine is transmitted by two belts, each eighteen inches wide, applied to pulleys eight feet in diameter, the engine making seventy-five strokes per minute. This gives a velocity of 1875 feet per minute for the belt, and, as the horse-power is 125, or 4,125,000 pounds raised one foot high per minute, it is easy to determine from these data the actual efficient tension of each inch of the belt. The velocity being 1875 feet per minute, and the aggregate width of the belt 36 inches, we multiply these together and divide 4,125,000 by them.

$$\frac{4,125,000}{36 \times 1875} = 61 \text{ lbs.}$$

Sixty-one pounds is therefore the actual efficient tension of the belt when the engine is developing and the belt transmitting 125 horse-power. This is in excess of the safe limit of tension generally recommended; but we may here remark that belts of the width here mentioned are generally thicker and stronger than the average belts used in machine-shops, and from which the ordinary data were taken. They are, therefore, capable of sustaining a greater strain, and of transmitting more power. But, from a careful examination of a great number of cases of belts of ordinary width and strength, we find that a safe and judicious limit lies between forty and fifty pounds. In order to increase this, however, it is not unusual for engineers to double the thickness of the belt, by cementing or riveting two thicknesses of leather together. But this plan, though advisable in some cases, is not so economical of power and material as the equally efficient plan of increasing the width of the belt.

The proportion between the actual and the efficient tension of the belt depends upon a variety of circumstances, the efficient tension being always less than the actual. By efficient tension is meant that part of the strain upon the belt which is directed to causing the driven pulley to revolve. If we suppose the friction between the belt and the pulley to be very great, and that the belt—by reason, it may be, of great length, causing the upper part to sag—envelops a large arc of the pulley, it might very well happen that the tension of the upper half of the belt (which is presumed to move horizontally, and to be the slack side, would be almost nothing, and, consequently, that the effective tension would be almost equal to the actual. For it is evident that, if a belt pulls a pulley in any direction, the actual force applied to the pulley to cause its rotation will be the difference between the forces which are exerted in opposite directions. For tension in a belt or cord supposes that a force is exerted to drag it in two opposite directions, and, consequently, while the tension in one half of the belt tends to drag the pulley in the required direction, the tension in the other half tends to drag it in the opposite direction.



Thus, if the pulley A drives the pulley B in the direction of the arrows, as shown in the figure, then the upper part of the belt will be slack, and the under part tight. The belt moving from *d* to *c* tends to drag the pulley B round with a force which is equal to the tension of the belt between *c* and *d*. But the tension of the belt between *a* and *b* evidently tends to drag the pulley B round in a direction opposite to that of the arrow. It is, therefore, the difference between the tension of the two sides or halves of the belt that is a measure of what may be effective tension of the belt. When the driven pulley moves easily and offers no resistance, the tension of the two halves remains equal; the effective tension in this case is nothing, and no power is transmitted.

But if we now increase the resistance of the driven pulley—as, for example, by making it do more work—then the upper part of the belt becomes more slack, the lower part becomes more tense, and consequently the difference between the tension and the two halves—in other words, the effective tension—increases. If we try to increase this effective tension beyond a certain point, we find ourselves limited by two circumstances—the strength of the belt, and the friction between it and the pulley. Except in the case of old and badly-joined belts, the ultimate limit of the strength of the belt is never reached. Friction, as we have previously shown, depends largely upon the pressure exerted by the belt upon the pulley; and this, of course, depends upon the tension. It depends also upon the character of the surfaces; and attempts are often made to increase it by smearing the surfaces of the belt with rosin and similar substances.

Recently a writer in the *Journal of the Franklin Institute*, who seems to have made a specialty of the subject of belting, recommends the use of printer's ink as a means of preventing pulleys from slipping. That it will produce the desired effect we have no doubt, but it will be at the expense of a great waste of power.—*The Textile Manufacturer.*

RESOURCES OF SERVIA AND BOSNIA.

THE small extent of country upon which the eyes of Europe are now centred lies too far out of the beaten tracks of travellers for much to be generally known as to its capabilities or natural resources; nevertheless the country is described in the few existing works as being very fertile, and the soil might be made much more productive were it not for the idle and dirty habits of the people. The mines of Servia and the forests of Bosnia are two of the principal sources of revenue to the countries. Both iron and copper can be obtained, not only in large quantities, but also of excellent quality.

One of the most valuable products, both of Bosnia and Servia, as at present developed, lies in their plum crops, many of the peasantry depending entirely on these fruits as the means of subsistence through a great part of the year. The plums, after being gathered, are mostly dried in the form of prunes, the secret or art of drying being known only to themselves. The Bosnian plums are considered of a better quality than those either from Servia, Croatia, or Austria. A quantity of spirit is likewise prepared from these fruits. Amongst other vegetable products of the country may be included tobacco, potatoes, flax, hemp, walnuts; and amongst cereals, wheat, maize, barley, oats, rye, millet, etc. Wheat and maize are the principal food plants consumed in the country, some of the other products being exported in comparatively large quantities.

The traffic in pigs is great, the value of which amounts to nearly one half of that of the entire exports of the country. In one year 472,700 of these animals were exported from Servia, the bulk of which are fattened at Sombruch, near Pesth, in Hungary, where more than 500,000 pigs from various parts are fattened yearly. Their value is not on account of their flesh as an article of food, but exclusively for melting down for their fat.

GOLD AND SILVER.

MINING in the precious metals received a new impulse on the discovery of gold in Australia and California, and of the extensive deposits of silver in Colorado, Utah, and other western states and territories of the American Union, so that among the mining enterprises of the British capitalist foreign and colonial gold mines and foreign silver mines have commanded extensive attention. The numerous reports and frequent correspondence given in the Journal show the interest taken by many of our constituents in these departments of mining, and the large amount of capital engaged in quartz crushing for gold, and to some extent in the search for alluvial and stream gold, and, perhaps, the still larger quantity of capital employed in mining for silver, sometimes found in its virgin state, but more frequently with lead and other metals. It is, therefore, appropriate that we look at the prospects of our gold finders and silver miners, so as to afford some assistance to the judgment of contemplated investors in such undertakings, and haply some encouragement to those who have embarked in them, and whose proceedings, hopes, fears, and opinions our columns from time to time record.

At no period in the world's history was there so much gold as now. We read, it is true, of fabulous amounts in remote antiquity, and also of well-authenticated stores of both the precious metals; but it is observable that they were chiefly laid up in the treasuries of great monarchs or great men, or expended in the decorations of palaces, fanes, temples, or in constituting royal and imperial badges and emblems, such as crowns and sceptres, or in ornamenting swords, spears, and other weapons of war, such as were wielded by royal personages, or great military chiefs. The most singular use to which we have any record of silver having been put was by the Indians of Arizona and Mexico, with whom it was so plentiful, so much more plentiful than lead, that they used it for bullets in their contests with one another and with the pale faces. At present gold and silver are in the hands of large portions of the population of civilized countries. The Bank of England possesses more gold in its coffers than ever it had before, in round numbers 33 millions. The Bank of France has stored twice that sum. There are in the national banks of Europe and America probably not less than 140 millions. Germany and Holland have adopted a gold standard of currency, and the United States of America is about to substitute a metallic circulation for its greenbacks.

The effect of this great increase in the world's stock of gold has been to make money (that is, gold) cheaper, and to reduce the rate of interest in all countries, except where it is exceptionally scarce, as in Russia, Turkey, and Spain. This, of course, affects injuriously the recipients of salaries and fixed incomes, contracting their purchasing and expending power, and to that extent restricting trade; while, on the other hand, it raises the prices of all commodities which it is employed to purchase, again limiting business. Col. Perronet Thompson (afterwards General Thompson) used to say that in 20 years after the discovery of gold in Australia all commodities would be raised 10 per cent., and this prediction has been fulfilled. Nevertheless, we are not of opinion there is too much gold, because in its economical action it creates a demand for itself, and, therefore, keeps within certain determinate limits the increased price of commodities produced by its abundance. The more gold the more enterprise, and the more will be used for ornamental and other practical purposes. These are obviously facts, for the age of enterprise may be said to have commenced with the discovery of gold in Australia and California, and at no former period was the metal used to such an extent in the arts and for domestic articles and personal decoration, so that in England alone the amount of gold consumed annually has rapidly risen from 1,000,000*l.* to 5,000,000*l.*

With this view of the matter, present and prospective, we say to the gold seeker, be of good cheer. The day when you will not be wanted is a far distant one, if ever it arrive, and we feel sure the work of the gold digger will last as long as the world. We can not doubt that fair and reasonably speculative adventure in gold mining, whether in California, Africa, or Australia, is worthy the enterprise and productive spirit of British capitalists.

Silver has been more plentiful than gold in all ages, but its consumption in oriental lands has always been enormous. Pliny bears testimony that in his days India drained Europe of its silver. Since the East India Company sent its first "writers" to Bengal the export of silver from England to India has been prodigious, quite in keeping with the dictum of Pliny. But of late this has not been the case. Sovereigns have passed into circulation among the higher classes of the natives: and it is said that the rulers of such independent and *quasi* independent states as these are, hoard them. Golden ornaments, such as armlets, bracelets, anklets, broaches, and rings, are affected by wealthy natives, who used to be content with silver decorations of this sort. Paper rupee money is found more convenient than silver, and all things considered equally secure. Ornaments in temples, gold-, and their

decorations, which used to be made of silver, are now to a great and growing extent composed of zinc. From these and other causes, and the course of commerce, the demand for silver has much diminished in India, even to the derangement of the exchanges, which have been further influenced by the production which has so rapidly augmented in the United States. Some confusion, loss, and obstruction to trade have ensued. Colonel Perronet Thompson, one of our ablest British political economists (already quoted), used to say "It will be a serious thing for the holders of gold, or property which represents gold, if silver should abnormally increase. Such augmentation has taken place with some of the troubles foreseen, but the investors in silver mines need not be afraid of them. As in the case of gold, so in silver, the demand for all purposes except currency will be enlarged. There are innumerable articles for which silver is adapted better than gold or any other metal, for which it will be employed, preventing depreciation to any serious effect. The surprise to commerce, created by the somewhat sudden over abundance, will adjust itself in the course of events, as fragments of rock, however angular, when shaken in the sea become rounded pebbles. We have imported only three-quarters the value of gold this year as compared with the corresponding period last year, and Russia has absolutely sent us none, the supply of the Ural Mountains having failed, and notwithstanding the outcry about surplus silver we have barely imported 300,000*l.* more than in the first half of 1875, while we have exported three-quarters of a million more, which all went to India. Our export of gold has been 3¼ millions less, which partly accounts for the glut in the market, and the heavy stores in the vaults of Threadneedle-street. When the effects of overtrading, wild speculations, and dishonest commercial proceedings, have passed away there will be room for the employment of all we have. Meanwhile, let the miner for gold or silver be of good heart, and dig and delve, and sink his shafts, and direct his levels, for all his returns will be required.—*The Mining Journal.*

AN ANCIENT ROMAN VILLA.

AT Pompeii are to be seen many specimens of houses formerly inhabited by Romans in the middle and lower ranks of life; and the younger Pliny has described, distinctly, the villa of a rich Roman nobleman. This description refers to his winter residence at Laurentinum, about seventeen miles distant from Rome, in the latter part of the first century. This is the description, which the ingenious reader may illustrate by a plan: "My villa," Pliny stated, "is large enough to afford all desirable accommodation, without being extensive. The porch before it is plain, but not mean, through which you enter a portico in the form of the letter D, which includes a small but agreeable area. This affords a commodious retreat in bad weather, not only as it is inclosed with windows, but particularly as it is sheltered by an extraordinary projection of roof. From the middle of this portico, you pass into an inward court extremely pleasant, and thence into a handsome hall which runs out towards the sea. On every side of this hall there are either folding-doors or windows equally large, by which means you have a view from the front and two sides, as it were of three different seas; from the back part you see the middle of the court, the portico, and rear; and by another view you look through the portico into the porch, whence the prospect is terminated by the woods and mountains, which are seen at a distance. On the left hand side of this hall, somewhat farther from the sea, lies a large drawing-room, and beyond that a second of smaller size, which has one window to the rising and another to the setting sun. The angle which the projection forms with this drawing-room retains and increases the warmth of the sun; and hither my family retreat in winter to perform their exercises. Contiguous to this is a room forming the segment of a circle, the windows of which are so placed as to receive the sun the whole day; in the walls are contained a set of cases, which hold a collection of authors whose works can never be read too often. Thence you pass into a bedchamber through a passage, which, being boarded and suspended over a stove which runs underneath, tempers the heat which it receives and conveys to all parts of the room. The remainder of this side of the house is appropriated to the use of my slaves and freedmen; but most of the apartments are neat enough to receive any of my friends. In the opposite wing is a room ornamented in very elegant taste; next to which lies another room, which, though large for a parlor, makes but a moderate dining-room. Beyond is a bedchamber, together with its ante-chamber, the height of which renders it cool in summer, as its being sheltered on all sides from the winds makes it warm in winter. To this apartment another of the same sort is joined by a common wall. Thence you enter into the grand and spacious cooling-room belonging to the bath, from the opposite walls of which two round basins project sufficiently large to swim in. Contiguous to this is the perfuming-room, then the sweating-room, and next to that the furnace which conveys the heat to the baths. Adjoining are the two little bathing-rooms, fitted up in an elegant rather than in a costly manner. At the other end is a second turret in which is a room that receives the rising and setting sun. Behind this is a large repository, near to which is a gallery of curiosities, and underneath is a spacious dining-room. It looks upon the gardens and the gestatio (promenade) which surround them. Between the gardens and this gestatio is a banqueting-room. Two apartments run round the back part of it, the windows whereof look upon the entrance of the villa and into a pleasant kitchen-garden. From hence, an inclosed portico extends, which, by its great length, you might suppose erected for the use of the public. It has a range of windows on each side; but on that which looks towards the sea, they are double the number of those next the garden. Before this portico lies a terrace perfumed with violets. On the other end of the terrace and portico stands a detached building in the garden, which I call my favorite, and, indeed, it is particularly so, having erected it myself. It contains a very warm winter-room, one side of which looks upon the terrace; the other has a view of the sea, and both lie exposed to the sun. Through the folding-doors you see the opposite chamber, and from the windows is a prospect of the inclosed portico. On that side next the sea, and opposite the middle wall, stands a little elegant recess, which, by means of glass doors and a curtain, is either laid open to the adjoining room or separated from it. Adjoining this is a bedchamber, which neither the voice of the servants, the murmuring of the sea, nor even the roaring of a tempest can reach. This profound tranquillity is occasioned by a passage which separates the wall of the chamber from that of the garden; and thus, by means of that intervening space, every noise is excluded. Annexed to this is a small stove-room, which, by opening a little window, warms the bedchamber to the degree of heat required. Beyond this lie a chamber and ante-chamber, which enjoy the sun, though obliquely, from the time it rises till the afternoon."

THE CITY OF BRUSSELS.

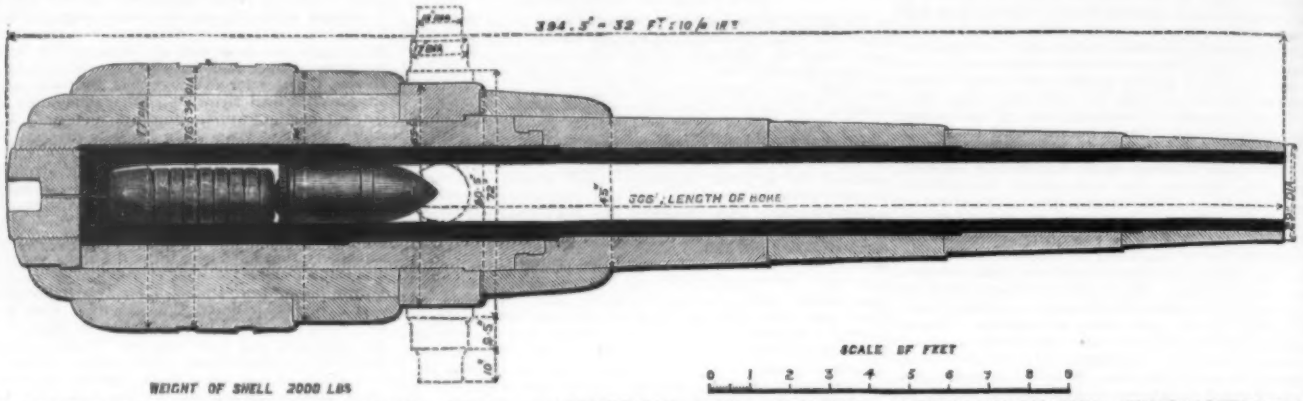
BRUSSELS, when the writer visited it for the first time forty-two years ago, contained about 80,000 inhabitants; it now, with the suburbs, which are practically Brussels, numbers 400,000. Though from time to time, at intervals, he has paid visits to this thriving capital, the enormous progress made in the last few years is still most striking. In addition to the extension of the city into the suburbs, numerous crowded and unhealthy quarters, with narrow, crooked, and ill-drained streets, have been entirely swept away, and are replaced by superior buildings, broad streets, and well-planted avenues. An excellent and commodious system of street tramways adds greatly to the convenience of getting about, and these are largely made use of by all classes. The carriages are light, and so made as to run readily round sharp curves. Some are drawn by two horses, and some by only one; some are open at the sides, with rows of seats *char-a-banc* fashion, and an awning to shade from sun or rain, and some have side curtains; while others are entirely closed, having a division, by means of a sliding door, to separate first and second-class travellers, the fare varying according to class or position of seat. It is evident that the traction must be far less heavy than that on the London trams, for the small Flemish horses employed trot away with their burden at a good pace, and are in excellent condition; in fact, they will bear no unequal comparison in that respect with those employed in our private carriages. Within the last few weeks steam has been pressed into the service, and a steam-drawn tram-car has been and is in actual daily use on the Bois de Cambre line. A small engine of compact character, burning coke and making neither noise nor smoke, the invention of M. Duroy, precedes and drags an ordinary car with ease and facility. It is under perfect control, stops readily, and runs at one part of the line over a gradient of 1 in 33 without any difficulty and without alarming the horses met with on its journey. The engineer stated that so far as their experience had gone, it was considered that the cost of the steam system was 20 per cent less than that of horses. Former visitors will recollect the filthy tortuous stream of the river Senne, running through the city, dark and foul from all sorts of abominations collected in its course from the narrow, ill-conditioned streets which abounded in that direction. This has been entirely abolished, the course of the river has been diverted into a more or less straight channel, covered over entirely from one end to the other, with a large intercepting main sewer on each side. These works are on a grand scale, and do credit not only to the engineering skill with which they are designed and constructed, but to the broad and comprehensive views taken by those entrusted with the administration of the city. New streets, new houses, and a broad handsome boulevard, well planted with an avenue of trees, now take the place of the expropriated quarter. The sewage at present is not utilized, but simply taken into the Senne below the town. It is, however, decided to employ it on a farm as the best means of dealing with it, and the delay in adopting this course has hitherto arisen from the very heavy demands made by proprietors for compensation. The clearance round the cathedral is very striking, as that noble pile can now be seen to advantage. Since the writer visited Brussels a few years since a grand and commodious Conservatoire of Music has been built, superseding the old and inadequate structure then used for the purpose. The new building is a handsome massive structure, and consists of two wings and a centre, forming three sides of a square. It contains, besides the necessary offices, twenty lofty class-rooms, large and small, a library, and a theatre and concert-room combined, adapted for holding about 1500 persons in capacious stalls and boxes. An organ for teaching purposes, of three rows of keys and thirty stops, is placed in one of the lower rooms. A large organ for the use of the concert-room is in the course of construction. A residence for the Director is about to be built adjoining the main building. All Belgians are entitled to the privileges of instruction in the Conservatoire, for a nominal fee of 5 francs. Foreigners pay 200 francs, about £8. Not far from this building is the new Palais de Justice, an enormous structure, which it is intended shall be finished in 1880, marking the era of the 50 years' existence of Belgium as an independent kingdom. Without entering into the exact dimensions of this building and our own law courts, the Brussels Palais de Justice will, when complete, compare with them favorably, both in point of size and solidity. The Bourse, too, an entirely new building, is worthy of the city, and the arrangements for the convenience of the merchants and bankers attending to transact their business there are very complete in character. It is in electric communication with every leading commercial town of note. The Bureau des Postes is also noteworthy. There is in operation a very simple and convenient system of public clocks, placed at the corner of some of the principal streets in electric communication with the Observatory, by means of which correct time is displayed. This, however, is not new; but it is worthy of consideration whether some such system could not be adopted in our own metropolis. All these buildings and constructions, except the trams, which are in the hands of two companies, are erected, and the administration connected with them maintained, at the public cost, and bear remarkable testimony to the wealth and thrift of this nation; for, in spite of these large expenditures for public works, it does not appear that the taxation, imperial or local, is by any means heavy.—*Journal of the Society of Arts.*

THE MANUFACTURE OF BRUSSELS CARPETS.

THE textile floor-covering known as Brussels carpeting appears to have been first manufactured at several towns on the Continent, and is of Flemish origin. Some of the earliest hand-looms for weaving it were set up at Brussels, and from that place it takes its name, although the chief seat of the manufacture has long been transferred to English ground. Hand-loom weaving is now nearly extinct, except for trial slips, so that we shall not enter upon any detailed description of this method of manufacture, but confine our remarks to the productions of the Brussels power-looms, the earliest of which was, we believe, invented by Mr. Bigelow about the year 1845, and was purchased by Messrs. John Crossley & Sons, of Halifax, for £10,000. This loom was by the year 1852 much improved by Mr. John Collier, who was at that time employed by Messrs. John Crossley & Sons for that purpose, and soon after that the firm in question ceased weaving by hand-looms altogether, and by the steady improvement of the power-loom, and the constant purchasing of all alterations and advantages offered to them from time to time by various inventors, commenced building up the enormous business which has long been celebrated throughout the world. Before Messrs. Crossley & Sons purchased Mr. Bigelow's invention, it had been offered by him to the manufacturers of Kidderminster, who refused it, and now that Messrs. Crossley, having got into thorough working order, were able to produce carpets quicker and cheaper than by the old hand-loom process, those engaged in the trade at Kidderminster found it necessary to move with the times, and to apply to the owners of the patent for licenses to work the power-looms, and for many years royalty was paid to Messrs. Crossley for every yard of Brussels carpet produced outside their own factory, and this alone must have brought that enterprising firm an immense revenue. Kidderminster, which for many years wove Brussels carpets in hand-looms, has long been the metropolis of the trade, and there are at the present time in the town and district about twenty-seven firms engaged in the manufacture by power-looms, the old hand-looms having almost entirely disappeared, though many of the factories which contained them are still standing, but, as they are unfit for the introduction of steam machinery, they have been utilized for rug-weaving, or turned into cottage and warehouse property. Brussels carpets have always been especially noted for two important advantages over many other descriptions, namely, their adaptability to the production of an endless variety of designs by means of the jacquard, and their excellent wearing capabilities, the latter being a consequence of the nature of the fabric, which is a series of soft wool loops, formed by wires, and these loops, upon being pressed by the foot, give way, and rise again for a long time without sustaining any damage.

In order to obtain the beautiful patterns so well known as appertaining to the fabric under consideration, much previous labor is necessary. Designs suitable for the purpose are either drawn by trained artists upon checks or squares, each representing a stitch of the carpet, or are first painted in miniature as "models," as they are called, and are then transferred by copying as nearly as possible upon the ruled paper. The colors used longitudinally must not exceed five, which is the normal standard, though of late years some carpets are woven with six distinct colors or frames, and these are of course of better quality than the others. Across the carpet, which is woven ¾ yard wide, any number of colors may be placed by a method known as "planting," which may be explained as the judicious intermixture of various colored bobbins into the frames behind the looms, instead of keeping each frame to one color. The object of "planting" is to introduce more colors into the carpet than is apparently allowed by the frames containing the bobbins, and yet to do it in such a way that stripes of one tint are not seen, and that the carpet may possess the tints and colors of a five or six frame, while containing only the yarn found in a three or four frame. It should be borne in mind that the "frame" is the stand containing the yarn to be woven, and is placed behind the loom, each frame containing 216 or thereabouts bobbins, and being a thickness of yarn in the carpet which is said to be a three, four, or five frame, according to the quantity of full breadths of color it contains. After the design alluded to above has been made, the planting, if any, put in, and the whole colored by hand to exactly represent the finished carpet, but on paper, this paper pattern is taken to the stamping machine, that the cards may be prepared according to it. These stamping machines are attended by girls, and consist of iron frames fitted with perforated steel plates made to an exact size, and containing small steel punches. The colored paper pattern of the carpet, painted on squares, like the slipper or wool-work patterns often seen in shop windows, rests on a stand, which allows only one row of stitches to be seen at a time, in front of the workwoman, who, taking the plate containing the loose punches out of the machines, very quickly arranges them to produce the pattern indicated by the painting. A plain card is then placed in the machine, and the whole of the plates being in their places, the driving pulley is thrown into motion, and the card is accurately punched with clear round holes, and is laid in order with others, the arrangement of the punches being altered for the next one. The cards are then sewn or looped together in their proper order to the width of three, and into larger bands for working round the cylinder of the jacquard at the top of the looms. This work is performed entirely by girls, known as stampers, and they are among the most respectable females employed in the carpet trade, attain great speed and dexterity in their calling, and earn good wages. At this stage of the proceedings the design, being embodied in jacquard pattern cards, is perfectly ready for the loom, and the painting on the squares can be stored away for the reproduction of fresh cards should the design take with the public and require several looms to produce carpets enough to supply the demand for it. But many patterns are stamped, and the first specimen yard and a half or bedside of carpet is woven, and no more, while some manufacturers even produce some carpets of medium appearance to act as foils to their more superior patterns.

In the production of a Brussels carpet there are a number of processes to consider, each of which, in these days of excessive competition, must be worked with the greatest economy, while at the same time the best results must be produced. The worsted yarn, of which the fabric is woven, is spun in various counts from 10's to 18's, and must be strong enough to bear the strain of a power loom, which of course is greater than it was in the old hand loom, where a weaker and softer material could be used, and where, comparatively speaking, the cost of knotting-up when breakages occurred was not so great. It is also necessary to buy a pretty full plump yarn, and one that, while running as long a count as possible, yet avoids leanness and "covers" well. There are of course numerous spinners who prepare worsted solely for this and the tapestry trade, and the classes of wool used are all pretty long. Of late years less English wool has been employed than formerly, it being dear, and a good deal of it requiring sorting. But little hand sorting is done now, Oporto, Persian, and Russian wools being used, which are blended suitably in large quantities, and sent on to the carding engines. Most classes of colonial wools are too good and too dear for carpets of the description under consideration. The yarn having been spun and wound in large skeins, is sent to the carpet manufacturer in a greasy condition, and stores of it are thus kept ready for use, the first thing done with it being to wash away all the oil which was necessarily put in the wool during the spinning. This is done in a washing machine, which is a series of two tanks, one placed above the other, and separated by a pair of cylinders, another being at the top end of the two tanks, which are filled with soapsuds, and other washing ingredients. The yarn is placed on two revolving cylinders over the vats, which run it rapidly through the water, and being passed by the attendant over these drums, it ultimately reaches the end of the tank, and is placed in the steam rollers, which squeeze out the moisture. It then ascends the second tank in the same manner as the first, and goes through the top rollers, emerging from them very white and clean, nearly dry, and with all grease removed. This process is called "scouring," is performed solely by men, and when the yarn has been scoured it is placed on poles over the dye furnaces, and is ready for dyeing. —*The Textile Manufacturer.*



THE HUNDRED-TON GUN.—CONSTRUCTED BY SIR W. G. ARMSTRONG & CO., ELSWICK ORDNANCE WORKS, NEWCASTLE-UPON-TYNE.

THE 100-TON GUN.—THE HEAVIEST CANNON IN THE WORLD.

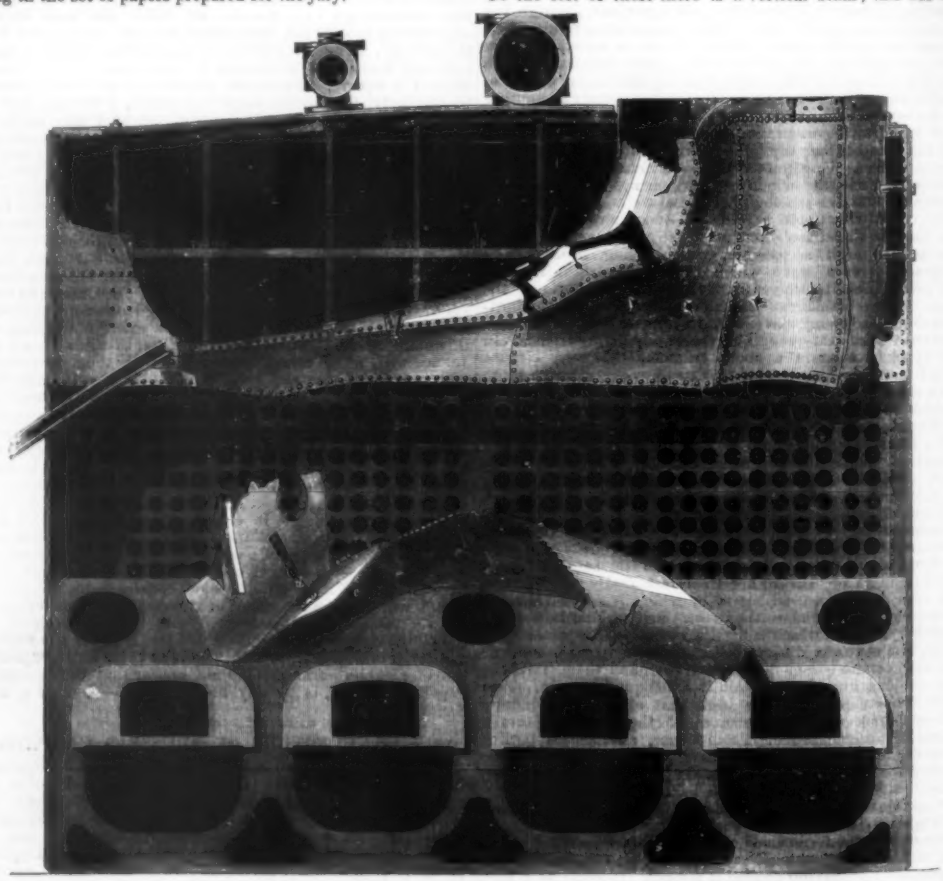
THE accompanying engraving illustrates the 100-ton gun which has just been completed by Sir W. G. Armstrong & Co., of the Elswick Ordnance Works, Newcastle-on-Tyne. Built for the Italian Government, this monster piece of ordnance is the first of eight guns to be placed on board the turret ships "Duilio" and "Dandolo," built the one at Spezia and the other at Castellamare, near Naples. The first of these vessels was launched at the arsenal of Spezia a few weeks ago, but it will yet require twelve months or thereabouts to complete her equipment, and within that time it is expected that the Elswick firm will have the three other guns required to complete her armament ready for delivery. With reference to the ships which are to mount the heaviest ordnance yet constructed, we may merely remark that each is furnished with two turrets, which, instead of being in the centre line of the vessel, are placed towards the sides, so as to get a clear fore-and-aft fire from either turret. The inside diameter of either turret is about 26 ft., and the outside 32½ ft., while each will weigh, including its guns, about 7000 tons. Each turret will be able to make one complete revolution in about a minute, and will be provided with hydraulic locking bolts to stop the turret when desired at the loading position. These bolts are of sufficient power to stop the whole mass at a moderate speed, and stay it in position during the operation of loading.

It is almost needless to remark that the 100-ton gun which left the Tyne last week for the arsenal of Spezia is the heaviest and most powerful piece of ordnance in the world, being 20 tons heavier than the huge guns with which it is proposed to arm the "Inflexible." It is constructed on the well-known Armstrong principle, the inner barrel being of steel, rifled with twenty-seven grooves, the spaces between which are about equal to the width of the grooves themselves. The weight of the gun is 101½ tons; its extreme length is 32 ft. 10½ in.; the length of the bore is 30 ft. 6 in.; and the diameter is 17 in. The outside diameter of the gun at the muzzle is 29 in., that at the breech being 77 in. The barrel is in two pieces, made into one in the building up. There are three layers of coils over the thickest end of the gun, and the steel tube is in two pieces, joined by a double ring, so as to make one tube. The rifling is an increasing spiral, on what is called the parabolic development, winding up with a twist of 1 in 45 calibres. The depth of the grooves is ½ in. throughout. The details of the loading gear are similar to those of the "Inflexible" gun, with slight modifications to suit the size and disposition of the guns. There is a preponderance or superior weight at the breech end of about 4 tons, which gives stability in working, inasmuch as the weight is always tending in one direction. The trunnions are not placed on the largest diameter of the gun, as is usual with heavy ordnance, but further forward, where the diameter is considerably reduced. Rotation is given to the projectile, which quits the gun at a velocity of about 1400 ft. per second, not by the usual studs fixed in the projectiles to fit the grooves, but by a copper gas check fixed into the breech end of the shell, which has projections upon it corresponding with the rifling grooves of the gun. Where the check bears against the shell, the shell is so formed that the check on being crushed against it by the pressure of the explosion and the charge presses firmly about it, and the gas check being caused to rotate by the rifling grooves causes the projectile to turn to take the same rotation. The loading gear is hydraulic. Upon opening a valve the ram-head advances and forces the shot up the bore to its seat against the charge. After firing the gun is brought to the loading position and slightly depressed. Then the hydraulic ram, which has a sponge head, advances rapidly up the bore, and when it reaches the breech end of the bore a valve in the head is opened and a powerful jet of water is brought to play on the powder chamber; thus, at the same time aiding in cleaning the bore, and preventing the possibility of any remnants of fire being left in the chamber. After the rammer has been withdrawn, the cartridge and the shot are in turn raised by a hydraulic cylinder to their proper position in front, and on a line with the muzzle, this and the remaining operation being performed by one man without moving from his seat beside the levers. In the working of ships such as the "Devastation," relays of forty men each are required every ten rounds of rapid firing, but it is expected that the use of hydraulic machinery will enable the same work to be done by ten men in the 100-ton gun, and with considerably less fatigue. One man per gun is sufficient for ramming it in and out, elevating or depressing; one man for elevating the shot and charge, sponging, cleaning, and ramming home; one man for sighting the gun and firing; and one man for priming the vent.

The weight of the armor-piercing projectile is 2000 lbs., and that of the proof shot 2500 lbs., being 1240 lbs. more than that of the 81-ton gun. It is calculated by Captain Noble that the work developed by the shot when it quits the muzzle will be about 39,000 foot-tons, as compared with a power of 24,000 foot-tons realized in the 81-ton gun. In other words, it is calculated that the one gun will give thirty per cent greater effect than the other. Of course it is by no means certain that in so ponderous a weapon the exact estimated work will be attained, but approximately a power equal to raising 39,000 tons a foot is confidently expected. The aggressive force of the shot is estimated as equivalent to piercing an armor plating 30 in. thick, with the usual backing of teak, but the greatest thickness of plating on the "Dandolo" and "Duilio" will be no more than 24 in., while the maximum thickness of the plating in the turret will only be 17 in., the plating of the ship being thus the same thickness at that of the "Inflexible," and 6 in. less than the calculated penetrating power of the guns which the vessels will mount. The cartridge measures 52 in. in length, and 15½ in. diameter. It is made up of 380 lbs. of pebble powder, in blocks of 1½ in. cube. Instead of being mounted on a gun-carriage of the usual ponderous description, the gun is elevated on a pair of small trunnion blocks, connected with compressers, which are placed immediately behind the trunnions, so that the strain of the recoil is directly given off in the line of its action. These blocks with their accessories will weigh 35 tons, and the compressers, used for the purpose of running the gun in and out, will be worked in common with all the other mechanism of the gun by hydraulic power, applied at a pressure of 800 lbs. to 900 lbs., from a pumping engine which may be erected in any part of the vessel.—*The Engineer.*

THE "THUNDERER EXPLOSION."

THE safety valves, which at the time of the explosion were loaded to 30 lbs., were at this steam trial loaded to only 12 lbs. per square inch. Our readers know that there is in connection with the flow of steam a critical pressure at which the expression for escape into the atmosphere changes, and that pressure is just under 12 lbs. For pressures above that, the escape of steam into atmosphere through a given orifice is nearly proportional to the gross pressure. Accordingly an experiment at 12 lbs. pressure may give data for the action of the safety valve at the highest pressures. The experiment was made entirely under the direction of Mr. Bramwell, and his report on this experiment will be one of the most interesting in the set of papers prepared for the jury.



THE EXPLODED BOILER OF THE "THUNDERER."

We understand that the valves opened just at 12 lbs. pressure, and that the experiment was continued for accumulation, the pressure rising to 19 lbs. If the fires were kept bright this would correspond to an opening of about ¼ in. in breadth for both valves. It is probable that the fires would not be nearly in racing condition; there might be some excusable trepidation felt by the stokers, and probably the steaming rate at which the fires were kept would therefore not be more than half their full power, or the lift of the valves would not give more than ¼ in. breadth of opening all round. It is to be hoped that the experimenters have carefully noted the pressures with the times to show the rate at which the pressure increased after the valves opened. An experiment of this kind made with a single valve would show clearly whether the valve got set by expansion after it opened, and the time at which it ceased to lift would be indicated by a change in the rate of increase of pressure. This experiment was concluded by suddenly opening one of the communicating valves: the names of those who did not then run from the stokehole will perhaps be given in the report.

There have been several other instructive experiments made with one of the sets of safety valves connected to a factory boiler at 30 lbs. pressure. The dockyard fortunately possesses facilities for exhaustively experimenting on every phase of the problem, and the inspectors seem determined to avail themselves of this to the utmost extent. Specimens of the iron cut from the exploded parts have been tested at the dockyard, and the result is just what might have been anticipated from the high standing of the contractors. On many of the fractured plates, and upon that plate which seems to have first given way, the "Bowling" stamp is legible.

The engraving will give our readers a good idea of the appearance of the exploded boiler. The only damage done to the boiler is in the front of the uptake and the front plates of the boiler at the uptake. At the top right-hand corner of the engraving is shown an angle iron connecting the top of the uptake to the crown of the boiler. The uptake at the top is rectangular, and the front of the uptake was a flat plate. We described this plate in our first notice as having been originally convex; it was, however, quite flat, with 1¼ in. screwed stays tapped into the ½ in. plate at the uptake, with the ends in the uptake riveted over and with double nuts on the ⅞ in. boiler front. The angle iron shown on the top of the boiler was continued round the top of the uptake at the same distance, 6 in. from the front. The three short stays shown at the side are similar to the above; the points have torn out of the side of the uptake, tearing the plate away at the holes. To the left of these there is a vertical seam; this was the corner of the uptake, a square corner, flanged. The flanging has been bent and the plate brought almost flat, and broken there as shown. There are nine screwed stays in the front of the uptake; the screwed holes for six of these are shown fractured. The plate is not so much injured at these holes as our engraving represents it; at the holes the plate is cupped considerably, but the fractures are merely cracks, three at some of the holes and five at others. There are two more of these stay holes: one is shown to the left of the lower four, and one to the left of the upper three is hidden by the projecting corner. These two stay holes are not fractured, and the cupping is scarcely perceptible, and all the stays from these screwed holes are otherwise uninjured in the piece of the front plate shown in the engraving. The representation

of this piece is not complete in detail, some pieces of angle-iron stay fastenings are on it, and the double nuts are on all the screwed stays. These screwed stays in one of the opposite boilers are vertically 20 ins. from centre of rivets in top of uptake, 15¾ ins. vertically between the two rows, and 10½ between the centre of lower row and the centre of rivets on lower edge of front. They are spaced horizontally at 15 ins. and 15½ in. centres.

The safety-valve connection is just hid by the bend in the plate. Seven longitudinal stays were fastened to angle irons on the front by pins; the angle irons have all torn in the web at the pin holes; pieces of the web are shown still in some of the stay joints. The angle iron below the position of the manhole has broken across through the stay pin hole and two rivet holes which were nearly in the same section. The L-iron shown attached to the remaining piece of the front is one of the stokehole stays; at *c* and *d* on the torn front plate two more of these are shown. That at *d* is still attached to its angle-iron support, but the one at *c* has punched itself through the plate as described by us last week. The other short stays to the front, connected by palms to the top of the uptake, have drawn the nuts through the front plate—these holes are omitted on our engraving. The furnaces are uninjured, and it is only for simplification that the doors are omitted on the boiler front; except the smoke-box doors, which are gone, all the lower doors are in their place. The cause of the explosion referred the first fracture to about the place marked *c e e* on the displaced part. The last part to separate seems to have been the part between the two angle-iron stays *c d*, the rupture proceeding from *c* to the right while it was going on from *e e e* to left and right.—*Engineering.*

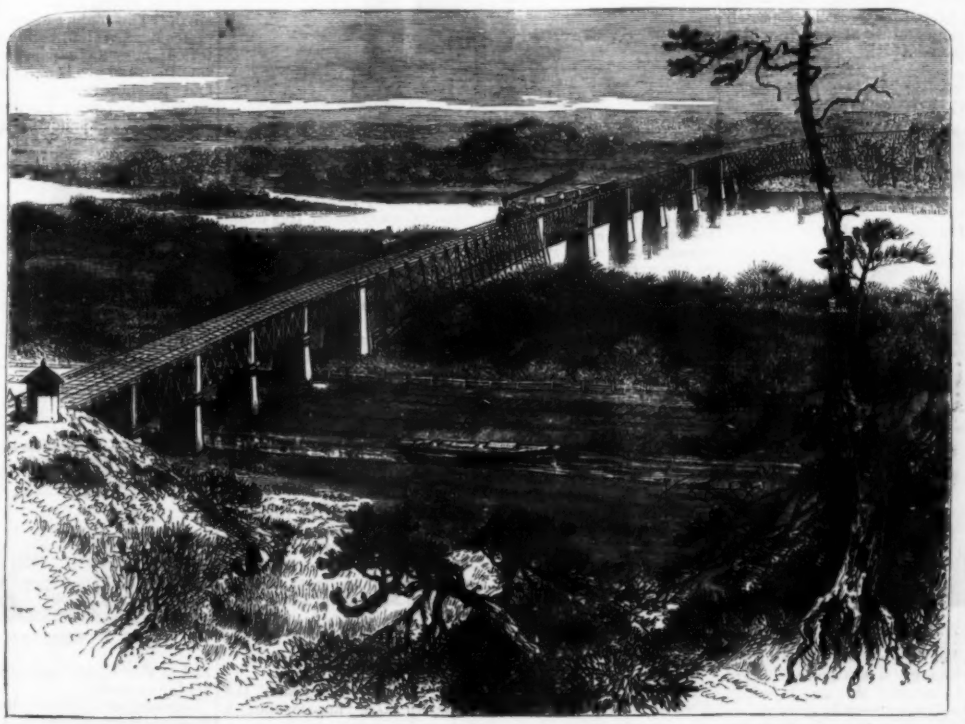
THE NEW PHILADELPHIA ROUTE.

THE YARDLEYVILLE BRIDGE.

WE have already recorded the opening on May 1st, 1876, of a new railroad route to Philadelphia, starting over the New Jersey Central, and known as the "Bound Brook Route." It is graded throughout for double track, has substantial iron bridges, and is laid with steel rails and stone ballast. It has been stocked with new and powerful engines, and cars of the finest finish, replete with all the modern appliances for comfort and convenience. The route, upon leaving New-York, takes the Central Railroad of New-Jersey, running over the most highly finished portion of this well-ordered road to Bound Brook; thence over the Delaware and Bound Brook Railroad, through the prosperous and highly cultivated Hopewell Valley to Yardley, where it crosses the Delaware River by a substantial iron bridge, affording a magnificent panorama of the river and the country for miles around; thence through the picturesque Huntingdon Valley, over the North Pennsylvania Railroad, to Philadelphia. The scenery along the line is of a beautiful character, and is particularly interesting from the fact that it is an entirely new region to railroad travel.

At Bound Brook the line diverges from the main line of the Central Railroad of New Jersey, over which the traveller has hitherto been journeying from New-York, and, crossing the Raritan River, runs off southwestwardly in an almost direct line to the Delaware River, a distance of twenty-seven miles. The country traversed by this portion of the route has been thus newly opened to direct communication with the two great cities. A fertile and well-watered farming country, dotted with farmhouses, and an occasional hamlet interspersed here and there, meet the eye. This whole region teems with Revolutionary reminiscences, having been the scene of marches and countermarches by detachments of both armies during the memorable campaign of 1777, when Washington recaptured both Trenton and Princeton.

The bridge at Yardleyville, which our cut illustrates, is a triumph of engineering skill. The entire length of the bridge, including the approaches, is 4000 feet, and it was built conjointly by the North Pennsylvania Railroad and Delaware and Bound Brook Railroad Companies, the dividing line being the middle of the Delaware River. It first crosses the Belvidere Division of the Pennsylvania Railroad and the Raritan Canal feeder—which lie here side by side—by two 60-feet spans and by a draw span of 182 feet, all of wrought-iron, and measuring 19 feet between the trusses. Beyond these, a timber trestle extends westward a distance of 622 feet to the river bridge, which, in turn, is 1448 feet long and supported on eight sandstone ashlar pillars and two abutment piers of combined ashlar and rubble. Six of the piers are in the river, and rest on a solid cobblestone substratum. The distance from rail to low water is 72 feet. The bridge is made up of nine spans, in length as follows, measuring from the pier centres and commencing at the eastern bank, namely: 1 abutment span of 60 feet; 1 span of 198 feet; 5 spans of 200 feet each; 1 span of 120 feet; and one abutment span of 60 feet. They are entirely of wrought iron, the post and top chords being made of plates and angle iron, riveted and latticed. No cast-iron is used except in washers, and the shoes of end posts. The floor system is made of built lateral beams tied together longitudinally by a series of built beams under each rail and over the centre of the truss.—*Frank Leslie's Illustrated Newspaper.*



THE NEW RAILWAY LINE BETWEEN NEW-YORK AND PHILADELPHIA.—THE BRIDGE OVER THE CANAL AND DELAWARE RIVER.

GERMAN AMBER.—The extent of the amber fields in Germany may be seen from the fact that twenty-two dredges, two tug-boats, one hundred barges, and one thousand laborers are engaged in the industry. The area of the amber field is extensive, and the Government derive from it a yearly rent of 72,200 thalers.

INTENSIFICATION OF NEGATIVES.

WHEN intensifying negatives of engravings with bichloride of mercury, its action must be carefully watched lest it destroy the delicate lines and obliterate them by an excess of precipitate. The image gradually becomes white, and, when no further action is apparent, wash well without delay. Proceed, finally, to produce an opaque brown tint almost impermeable to light. Pour into a glass a sufficient quantity of—

Water	100 c. c.
Hyposulphite of soda	3 grammes,
Concentrated ammonia	6 drops,

and with this flood the plate. The action is immediate; the white negative immediately turning to an intensely dark color, no further intensification is required. Adhere to the proportions of the intensifier given above. Wash with plenty of water and the negative is completed.

The composition of this intensifying solution is new, and it has been suggested by the results which produce the sulphide of ammonium. In fact, the formula has been compiled on such principles as will ensure, with the mercury of the image, the production of a black opaque precipitate.

One great advantage in this method of intensifying is that the disagreeable odors of sulphide of ammonium are avoided. The less ammonia escapes during the operation the better. If sulphide of ammonia be used, instead of the preceding, it should be diluted with water in the proportion of about one part of the sulphide to four of water. After applying it wash the negative well with water and weak gum before varnishing; for by doing so the vigor of the negative is better maintained.

Finally: a third means, which has given the best results, consists of replacing the reacting agents by an iodide solution:

Water	100 c.c.
Iodide of potassium	3 grammes.

After using it the image appears by reflection of a dull green color, but like black velvet when looked through. Iodide of cadmium, although it is more expensive, gives still better results with regard to intensity and stability. It is always after the application of the bichloride that these different reagents are used. The use of iodide gives the further advantage of perfectly clearing the lights in the negative and removing all traces of fog.—CTE. LUDOVICO DE COURTEN, in *Bulletin Belge.*

THE POSSIBILITY OF PHOTOGRAPHING SOUNDS.

IT has been possible to photograph so many phenomena, and to adapt the camera to so many scientific purposes, that it really becomes a difficult question to say where we shall stop. For barometric and thermometric readings, the sensitive plate has already been made to act as recorder; and in medicine, astronomy, navigation, and other sciences, the camera, as we know, has given us the most wonderful results. The latest speculation that has arisen in the scientific world anent photographic action is the question whether it will ever be possible to photograph tones and sounds as they are uttered. As we can photograph light waves, it would seem but a step further to secure a record of the waves of sound; and if a series of instantaneous views during the course of a speech, or the performance of a piece of music, could be taken—the record being secured upon an endless sensitive band, for instance—the curves or markings formed by such sounds might afterwards be capable of being read and rendered again. If this could be done, we say, we should at once render shorthand writing unnecessary, and clever stenographers would be of much less importance than they are now. Dr. Vogel, of Berlin, is of opinion that this idea of photographing one's speech is by no means so far-fetched as it may seem to be; and certainly, when we call to mind what has already been done in the way of registering sounds, we are disposed to agree with him.

All have heard of the sensitive flames which formed the subject of several demonstrations at the Royal Institution in Albemarle street, a little while ago. A gas flame of a certain nature is considerably influenced by vibrations of sound; different notes sounded in its neighborhood alter its shape and make it rise and fall perceptibly. To Mr. Barrett, we believe, is due the honor of having been the first to observe the phenomenon, and Dr. Tyndall subsequently lectured on the subject several times. The latter was at some pains to show his audience the degree of delicacy possessed by flames, and a brilliant display of experiments which he organized was thoroughly successful in doing this. In one experiment, if we remember rightly, the learned doctor recited a piece of poetry before a flame which actually went out when a certain word or sound was pronounced, and he distinctly proved that a most marked change overcame the flame as different sounds or vibrations were uttered.

The possibility of securing records of sound by means of photography rests upon this sensibility of flames to sound vibrations. M. König, of Paris, has lately constructed an instrument of a most simple character which renders visible the vibrations of any sounds uttered in its presence. The instrument consists simply of a burning gas-jet, the tube of which has at one spot an orifice covered with an elastic membrane. This membrane or drum is the means of influencing the flame. A person speaking or singing against the drum at once works upon the flame in a most extraordinary manner; as the sounds are uttered one after another, the flame takes up different forms, and these forms reflected in a revolving mirror give rise to a continuous light curve, which is governed by the sounds that are pronounced. So that a speech or song would be represented by a series of visible curves.

M. König has already sketched some of these curves as he has seen them, and it will therefore be but going a step further to photograph them. To do this, Professor Vogel points out, it would simply be necessary to provide the revolving mirror with clockwork, so that it might move at a given rate, and to employ a gas flame which is sufficiently actinic to produce an instantaneous impression upon the sensitive plate. For instance, cyanogen, although it has never yet been used in photography for such purposes, Dr. Vogel thinks might be employed with advantage, as it would probably give a very vigorous image; but this would, of course, be a matter of experiment.

That some practical results may be secured, therefore, in the matter of recording sounds by photography, there seems a great degree of probability, and if the flames can only be made to alter their shape sufficiently, records even of a delicate nature might perhaps be secured. We do not suppose, however, that the time will ever come when the staff of reporters at the House of Commons will be replaced by a sensitive flame and a camera. A monotonous curve would in that case represent brilliant and prosy speakers alike, and the innovation would at once get over that much-vexed question of "strangers," which is so often cropping up. Our legislators might hold their debates in private, without being influenced by the knowledge that every word they uttered is watched and weighed by galleries of spectators. The little gas tell-tale would be forever doing its duty faithfully and impartially, and when the house rose, all the eloquent and fiery speeches would be found recorded, sound for sound, as they were uttered, without any adornment from the hands of the reporters.

We say that we hardly expect any such high degree of perfection will ever be reached by applying the camera in this way as a recorder of sound; but we should not be at all surprised, nevertheless, to hear of some really useful and interesting results being obtained in the way of photographing tones and speech.—*Photographic News.*

OZONE FROM MANGANESE.

OZONE, although very effective in the destruction of offensive gases, has thus far not been utilized for this purpose for want of a cheap method of preparation on a large scale. Valmagini, of Vienna, states that a series of experiments conducted by him indicate that ozone is not only abundantly present in binoxide of manganese, and many other natural oxides of manganese, but also that these substances are remarkably well adapted for use in all cases where ozone would be effective. The following reactions are given in support of the statement: 1. Ozone test-paper, prepared with starch and iodide of potassium, is immediately rendered blue without the addition of an acid. 2. A solution of chemically pure iodide of potassium is immediately decomposed by fragments of the mineral, and the separated iodine can be detected by starch or bisulphide of carbon, or by volatilization. 3. Artificially prepared, chemically pure binoxide manifests precisely the same reactions. 4. The powdered mineral strewed upon chemically pure silver, and moistened, immediately produces a brown stain of oxide of silver, as is shown by its disappearance on ignition. 5. Air becomes ozonized by passing over the mineral, or surfaces coated with a powder of it. 6. Tincture of guiacum is turned a deep blue by these manganese minerals. 7. Gases resulting from putrefaction are also rapidly destroyed by them. A number of possible sanitary applications of them are suggested, among them the coating or plastering of sewers, or smoke and gas flues, the treatment of waste-water pipes, and use in manufactories, stables, cellars, etc.

THE effect of soil on the colors of flowers has often been a subject of discussion amongst botanists and florists. The Hydrangea is a notorious instance of a change from pink to blue, and *vice versâ*. Messrs. Stuart and Mein send to the *Gardeners' Chronicle* two trusses taken from two separate cuttings which were obtained from the one plant—one quite pink, the other a pure blue. Both cuttings were treated identically the same, potted from the same heap of soil, and watered with liquid from the same source.

PERIODIC MOVEMENTS OF THE FOLIAGE OF PLANTS.

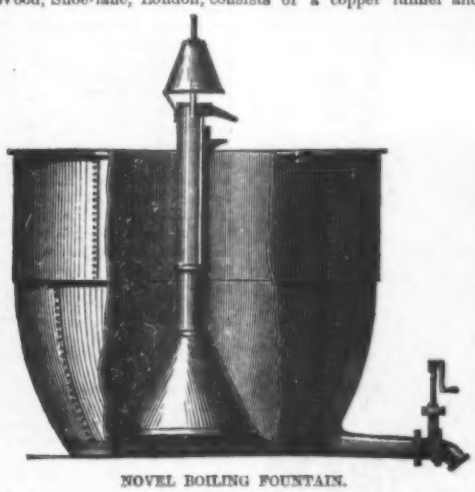
THE *Abies Nordmanniana*, a coniferous tree now widely diffused on account of the elegant coloration of its leaves, appears to bear uniformly whitish foliage when observed in the morning or toward evening, but when observed in the middle of the day the green tint seems general. The reason of this difference is found in the fact that the position of the leaves on the branch is different in the daytime from what it is at night; in the former case the leaves are spread out upon the branch and present their upper surface, producing the greenish aspect of the foliage; during the latter period, on the contrary, it is the lower or whitish surface that is presented to the observer. Thus there is a diurnal and a nocturnal position. As the day declines, the leaves, which at noon were horizontal, are seen gradually to erect themselves upon the branch, often becoming nearly perpendicular to it, and this movement of erection is accompanied by a movement of torsion in the basal part of the leaf, often traversing an arc of 90°.

WHY EARLY AUTUMN IS AN UNHEALTHY SEASON.

THE observations of the Munich Observatory show that the maximum and minimum of the mean monthly temperature of the ground vary within narrow limits, and the differences are always less the greater the depth at which the observations are made. Further, the maximum as well as the minimum of the mean temperature falls regularly at a later time the deeper the measurements are made. Thus, *e. g.*, at twenty feet the highest as well as the lowest temperatures do not occur until four months after the highest and lowest temperatures have been noticed a few feet above the ground. It is well known that the decomposition of organic matter is hastened by a high temperature of the ground. The favorable period for epidemics is that at which a relatively high temperature occurs with a certain degree of moisture. This is why the most and the worst epidemics occur at that time of the year when the soil is usually warmest (August and September), the fewest and generally the least serious when on an average the lowest temperature is found. The occurrence and spread of epidemics of this kind must be especially favored at times when the temperature of the ground is very high.—*Med. and Surg. Reporter.*

NOVEL BOILING FOUNTAIN.

THIS apparatus, manufactured by Messrs. Pontifex & Wood, Shoe-lane, London, consists of a copper funnel and

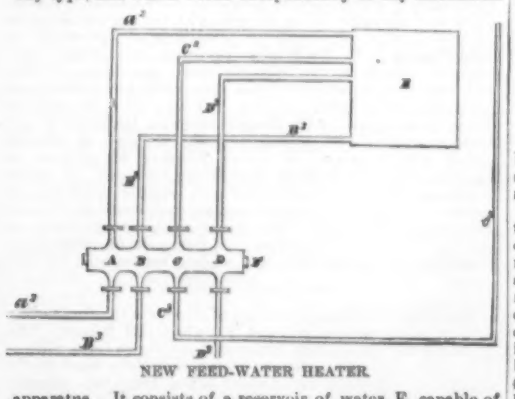


NOVEL BOILING FOUNTAIN.

vertical pipe so arranged that when it is placed in a brewer's copper over the hottest part of the fire a continuous upward current of the boiling liquor is induced through it, which passing out at the top of the pipe is depressed by the cowl attached to it, so that the liquor falls like a fountain back into the copper, and thus avoids all boiling over at top. With this apparatus the inventor finds the wort can be boiled with perfect safety to within 6 in. or 8 in. of the top of the copper without boiling over. It acts equally well when boiling a small quantity, and is furnished with a slide which can be adjusted to suit any depth of worts or liquor. The fountain simply rests on the bottom of the copper, and requires no fixing; and when desired can be immediately and readily removed by lifting it out by pulley blocks. This apparatus is applicable to steam pans and boiling backs with steam coils as well as fire coppers.—*The Engineer.*

NEW FEED-WATER HEATER.

WE extract from *Les Mondes* the annexed diagrams of a simple feed-water heater which may be applied to boilers of any type, and which works independently of any mechanical



NEW FEED-WATER HEATER.

apparatus. It consists of a reservoir of water, E, capable of supporting a pressure equal to that in the boiler, and surrounded by an isolating envelope. A B C D are four valves in the respective pipes leading from and to the reservoir, and all operated by the cock shown at F. The arrangement is such that when two valves are open the other pair are closed, and *vice versa*. Supposing the reservoir to be empty and valves C and D open, the tubes D^2 and D^3 allow the air to escape from the reservoir, while the tubes C^2 and C^3 conduct water from any source therein. When the receptacle is filled up to the opening of the tube D^2, the water is free to escape with the air; but at this moment the valves C D are closed and A and B are opened. Steam from the boiler then passes into the reservoir by the tube A^2, pressure increases as the water is heated, and finally the water is driven out and into the boiler through the tube B^2.

STEAM-BLOWER FOR SMITHY FORGES.

WE here illustrate, from Stummer's *Ingenieur*, a system of blast-forge brought out by Mr. E. Körting, of Vienna. The apparatus consists in its principal parts of an air accumulator,

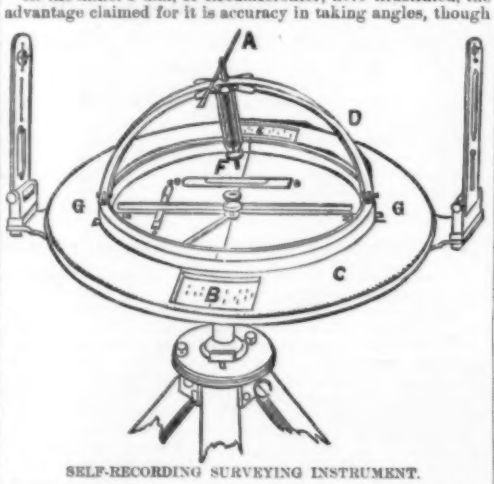
STEAM-BLOWER.

formed of a cast-iron tube opening below into a reservoir which serves at the same time as a base plate. At its upper extremity the accumulator supports a dome into which is fitted the blast-pipe *b*, the nozzle of which is adapted to the opening into the smithy fire. Immediately below this dome the steam-pipe traverses the accumulator with an exit at the opposite end, as shown. At this end is the aspirator, formed of three cones which admit air in their interspaces, whilst the steam jet is driven through the centre. The steam-loaded air passes through a conical eduction pipe into the reservoir which serves as a base plate, where the water of condensation is parted with, and the heated current of air passes into the accumulator under a tension corresponding to the dimensions of the aspirator multiplied by the pressure of steam. From the accumulator the blast passes through the nose pipe at *b* to the smithy fire. In this manner a blast is obtained, easily kept at any pressure, within certain limits, and at a temperature which very nearly reaches that of the steam used. In the engraving, *a* is the steam inlet, *b* the blast-pipe opening from the accumulator, *c* and *d*, outlets for water of condensation.

Körting's blast gives, with a pressure of steam of three atmospheres, an air pressure of 20 or 25 up to 50 centimetres of water. The air-blast is heated up to 100° Centigrade, and, in spite of its having been mixed with steam, issues all but quite dry from the accumulator. The apparatus can be set at work at once, wherever there is convenience for getting steam, and its low cost is a point in its favor.

SELF-RECORDING DIAL.

IN the miner's dial, or circumferenter, here illustrated, the advantage claimed for it is accuracy in taking angles, though



SELF-RECORDING SURVEYING INSTRUMENT.

by surveyors of even small experience, the tediousness of surveying is very much lessened, as the instrument requires no reading.

The following description will serve to explain its construction: B and E are exposed portions of a metallic paper margin or ring about 8½ in. outside diameter and 1½ in. wide, which margin is fixed to the base plate of the dial, and to which also the sights are attached. The base plate moves freely round, carrying the sights and paper margin, leaving the compass, the covering plate C, and remaining parts of the dial clamped to the legs. At D is a semi-circular arm, working over the compass on axes at G, G; this arm carries a brass marker A, which at one end is pointed, and at the other flat or knife edged. The paper margin is protected by a brass cover, C, which is fixed to the body of the dial, and only exposes the paper where required at the openings B and E, and for further protection a small shutter covers these open spaces while carrying the dial. If the pit should be very damp or dirty, it would be an extra precaution to use a double paper margin with a sheet of carbon paper between them; by this means a duplicate would be taken of all the angles of the survey.

The first process is to set this dial to the north point, and then to bring down the marker A, and puncture the paper both at B and E; these markings will give the north and south lines on the paper margin. Then take the angle required in the usual manner, and puncture the paper again, numbering each puncture on the margin; these numbers are booked, with distances, etc., to each. If two or more punctures should fall together on the paper margin, the marker A may be elongated by the screw F, so that half a dozen or more punctures may indicate the same angle without making any confusion in the margin. In plotting the survey the paper margin is removed from the dial, the north line or points on the paper margin are made to coincide with the north line on the plan, and the survey is plotted without the aid of the protractor, the paper ring serving as protractor, and giving all the angles required.

When the dial is required for setting out, a paper protractor is supplied in place of blank paper margin, and the angles read off by means of the marker A. Made by Messrs. John Davis & Son, of Derby.—*English Mining Journal.*

NEW METHOD OF HEATING GAS FROM MOTIVE POWER.

By W. N. HILL, Newport, R. I.

CONSISTS mainly in a novel method of heating gaseous matters to be employed in motors, by exposing a retort containing said matters to the action of heat evolved from quicklime or other suitable non-combustible matter, whereby smoke is obviated and the heating of the gaseous matters effected without the aid of atmospheric air.

In practice the retort C is first charged with the carbonic-acid or other gas in a liquid form under high pressure. The unslaked lime is then placed within the tank, and surrounding the retort C. The chamber D having been filled with water, the latter is allowed to drop through the pipe *d* upon the lime, either intermittently or continuously, as may be desired. The contact of the water with the lime at once generates heat, which, being imparted to the contents of the retort, induces an expansion of the gaseous matter. In this condition the gas is delivered from the retort into the pipe F, and passing through the bends of said pipe within the chamber E (water having been first poured upon the lime therein), the expanded gas is still further subjected to heat,

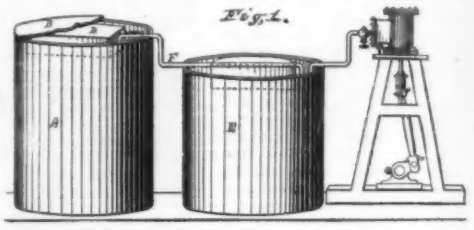


Fig. 1.

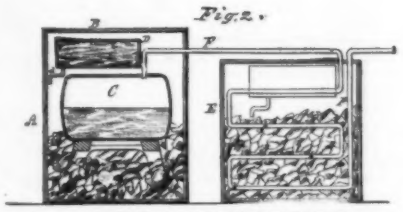


Fig. 2.

GAS-HEATER FOR MOTIVE POWER.

and in this highly-expanded condition is allowed to pass to the engine or motor.

Carbonic-acid gas having a very high tension, depending upon its temperature, it is evident that as the gas is taken from the retort C the tension will be lessened, unless the application of heat is continued until the whole of the gas has been driven from the retort. As the rapid expansion of gases inevitably induces a low temperature, it is essential that heat be employed for maintaining desirable tension.

By the arrangement described I am enabled to supply a large amount of heat, and thus, as the gas is drawn for use, to keep up its temperature, and consequently its tension. It is also desirable that the same or similar means be employed for heating the engine cylinder. In some instances the heat imparted by warming the retort C or the pipe F, or even the engine cylinder alone, will be found to fully serve the desired purpose.

In many special cases in which ammonia or carbonic-acid gas in a liquefied condition is especially adapted as a source for motive power, the use of the ordinary methods of supplying heat—such as by fire, steam, etc.—are impracticable.

The method herein described of supplying heat to carbonic-acid gas, etc., when it is undergoing expansion from the liquid state under high compression, maintains a high degree of expansive force.

If, instead of the unslaked lime, it should be desirable to use sulphuric acid or other chemical matter suitable for the purpose, it is obvious that the chamber for containing it should be provided against corrosion, and with an agitator or equivalent means, whereby the water and acid could be well mixed.

The invention has value in connection with operations with so-called submarine torpedo-boats, as the fires thereon are difficult to manage, and the smoke therefrom would render the movements of the boat conspicuous at times when it should be otherwise.

A NOVEL VINEGAR MANUFACTURER.

THE aquarium of the Jardin d'Acclimatisation at Paris has lately received a very rare present—namely, a polypus resembling a medusa. In a very short time all its companions in the tank died, and on looking for the cause, it was found that the water contained acetic acid, which was produced by the polypus. This remarkable animal is said to produce first alcohol and then acetic acid. The manufacturer has been put into solitary confinement, to enable him to continue his industry without damage to others.

ROLLER FLOUR MILLS.

By OSCAR OEXLE, C.E., Augsburg, Bavaria.

THE Roller Mills of Escher, Wyss & Co., Leesdorf, take a prominent stand among the various constructions in present use. This well-known firm had, as we have stated in a former article, an extensive experience in rollers, and the importance they attached to the self-acting lever pressure was such that they abandoned their old system of screw pressure, and turned to that of the lever with a combination of springs. They make various types of machines, of which we shall notice two. The first one (represented in Fig. 10) is constructed mainly for the purpose of breaking wheat, but is also used for reducing semolina and middlings. Four rollers (*a*, *b*, *c*, *d*,) are mounted in the frame (*e*), one above the other, and simultaneously pressed by one lever (*f*), with a movable weight. The pressure between the different roller surfaces can be altered by a simple mechanism, and so the distance between one roller and another can be changed. By this means the

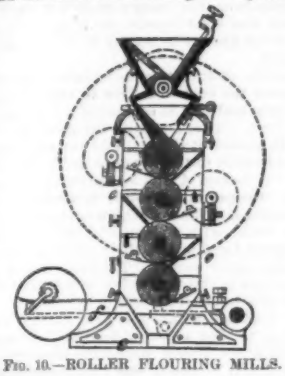


FIG. 10.—ROLLER FLOURING MILLS.

meal passing the roller is squeezed slightly between the top rollers, a little more in the middle, and most of all at the end roller. This triple action is approved of by many millers. The speed of all the rollers is equal, and they are of cast steel with perfectly smooth surfaces; they are 9 inches (Austrian) in length and 8 inches in diameter, and make 130 revolutions per minute. The capacity of work is nearly equal to the old roller stands shown in Fig. 8, but the construction is far simpler and the management a great deal easier. The price is also cheaper, amounting to about $500, delivered in Vienna.

Fig. 11 is a sketch of the newest type of rollers constructed by the Namur millwrights, and called the universal roller mill. The principle adopted is that of the single self-acting pressure by a combination of lever and springs. The two pairs of rollers performing the squeezing action lie horizontally in one line; the inner rollers are fixed; the outer are in movable bearings and pressed to the fixed rollers by a combined lever and springs. The meal to be re-ground comes by ing pulley, 30 inches; breadth, 6 inches; speed of driving pulley, 130 revolutions per minute. These machines are intended to squeeze semolina, middlings, and sharps, not for breaking the wheat. Their capacity comes near to that of one pair of millstones of 4 feet 6 inches diameter, but they do not reduce all the middlings at once into flour, although they produce a far superior quality than the stones. A number of different kinds of rollers are now being made by many millwrights, all more or less resembling in principle one or the other of the above described type, and varying only in small details. The meal from all these rollers comes from the machine in cakes, and if it could be brought at once to the silk and dressing machines, the greater part of the flour would pass in cakes over the reel and not be sifted. To this end already Sulzenberger, and later Escher Wyss, have fixed under the two top pairs of smooth rollers a pair of grooved rollers, with saddle. The new roller machines have no such apparatus attached, but to reduce the cakes several means are adopted; brushes, centrifugal sifting reels, and similar appliances fit to reduce the cakes are used. Sometimes the cakes are passed with slight pressure between millstones.

A new application of the self-acting pressure to rollers expressly built for the purpose of reducing middlings into flour has been lately constructed and patented by me. Figs. 12 and 13 show the machine. *A*, *b*, and *c* are smooth rollers of cast steel, and of 18½ inches length. The roller (*a*) is fitted in bearings fixed to the frame (*d*), and has a diameter of 13¾ inches; the two movable rollers (*b* and *c*) run in the bearings (*e*), and have a diameter of 8 inches. The transmittance of the pressure to the movable rollers is executed by hydraulic action. Fig. 14 shows on a larger scale the construction. The bearings (*e*) are cast in one piece with a plunger (*f*), which works into a press cylinder (*g*); a packing ring (*h*) tightens the piston and hinders the leakage of the liquid (oil, etc.) contained in the press cylinder (*g*). The four press cylinders (*g*) are connected by pipes (*i*); on the top of one of the press cylinders a stuffing-box (*k*) holds a pressing piston (*l*), which is forced into the liquid by the lever (*m*); by shifting the weight on this lever the pressure can be altered.

Should the rollers be released, the lever (*m*) is turned back and two springs (*o*) fitted on each bearing, lift the rollers *b* and *c*. It is driven by a pulley and by pinions, and a slight differential motion is given to the roller surfaces. Below the rollers a screw (*p*) brings the cake into the disintegrating apparatus (*q*) which breaks the cakes. The machine is mounted solid on the sole plate (*r*); the feeding arrangement (*s*) is carefully detailed, and the bearings are constructed so as to keep oil for two weeks' work. The new feature in this machine is the hydraulic action, which is perfectly equal on all bearings, a point most important for the efficient working of the machine, and which can not be attained to such a perfection in any other way. I have also adhered to the differential speed of the roller surfaces, as experience has shown me that a slight tearing action helps greatly to accelerate the grinding without spoiling the quality and color of the flour. This machine acts most perfectly, and fully does the work of a millstone of 4 feet 6 inches diameter. The meal coming from the disintegrating apparatus is ready for the dressing machines, and the power absorbed is 2 horse-power.—*The Miller*.

Fig. 14.

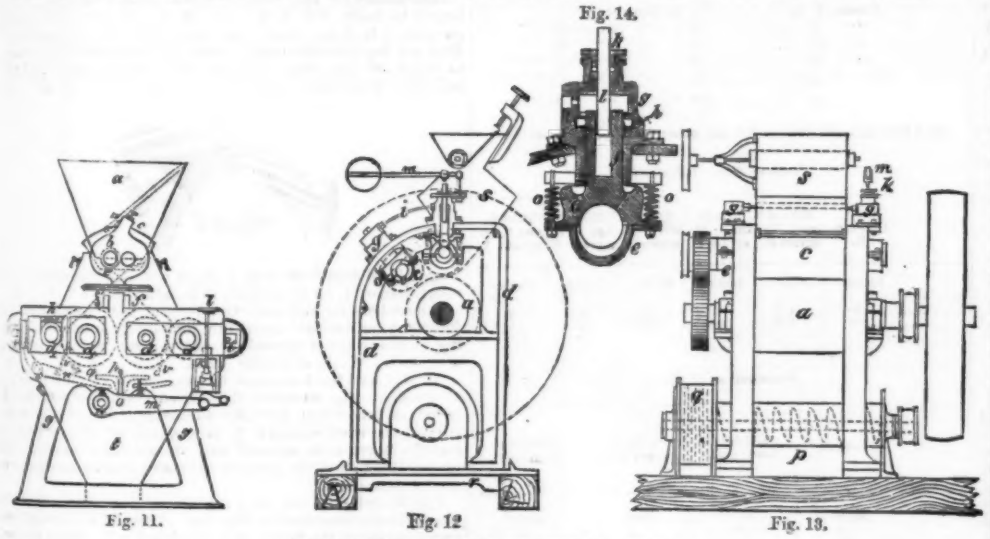


Fig. 11. Fig. 12 Fig. 13.

UNIVERSAL ROLLER FLOURING MILLS.

the hopper (*a*) on the feeding roller (*b*); a regulating slide (*c*) leads the meal on the two roller pairs (*d* d_1); and the cover (*e*) provides that the feed stops as soon as the rollers are out of action. Both pairs of rollers receive the feed from the feeding roller (*b*), which is grooved, and by the wooden cross pieces (*f*) an equal distribution of the feed is obtained.

The outer rollers (*d* d_1) have movable bearings, sliding in the frame (*g*) and the cover (*h*); the inner rollers are in fixed bearings bolted to the frame. The distance of each pair of rollers is fixed by the wedges (*i*), which press with their straight side on the movable bearings. These wedges allow the rollers to be set to the required distance just as the meal requires. The spring (*k*), which can be spanned by the hand-wheel (*l*), acts on the lever (*m*), which is keyed on the shaft (*n*); the knob (*o*) transmits the pressure by the point (*p*) to the cross-piece (*q*), which acts again on the levers (*r*), which move round the stud (*s*). The ends of the levers (*r*) transmit the multiplied pressure of the spring directly on the movable bearings of the outer rollers, and these again are pressed towards the fixed rollers. The meal, after passing the rollers, falls into the hopper (*t*), whence it is brought to further manipulations.

Sometimes it is required to take the pressure off the rollers, and this can be done by turning the handle (*u*), which sets the spring out of gear. The scrapers (*v*) keep the rollers always clean, and hinder any caking round them. The construction of the bearings has been attended to with great care, and the lubrication is self-acting, the bearings having chambers large enough to contain oil for two weeks' running. The whole machine is closed by a proper casing, so that any escape of dust is prevented.

The machine is driven by a pulley keyed on one of the fixed roller shafts, whereas the pulleys drive reciprocally one another by pinions. The dimensions of the machine are as follows: length, 4 feet; width, 3 feet 9 inches; length of rollers, 17 inches; diameter, 7 inches; diameter of the driving machine in the mill next trial. We think that our time card will remain undisturbed for awhile.

"Respectfully yours, J. F. LAWTON."

"Wild Moss Mills, Carrollton, Mo.,
"July 14th, 1876.

"The undersigned citizens of Carrollton and vicinity certify that at a trial made this day for the purpose of ascertaining the time in which bread could be made from wheat taken in the field standing, the following time was made by J. F. Lawton, proprietor of the mills: Commenced cutting with reaper at 3.1 p.m., finished cutting 3.2 p.m.; began threshing at 3.2½ p.m., finished one bushel at 3.3¼. Commenced grinding at 3.4¼, finished at 3.6¼. Mrs. Lawton began making bread at 3.8, finished at 3.8½. Griddle-cakes baked at 3.9½; and biscuit baked and eaten at 3.12; the whole accomplished in 11 minutes The reaper and thresher and the mill were thoroughly cleaned out before the trial commenced, and not a particle of flour was used that did not come from the wheat cut in the above trial. The undersigned witnesses kept separate time, and in the result all time agreed.

"Witnesses: J. R. Brown, circuit clerk, Carroll County; J. M. Tully, editor *Carrollton Democrat;* Joseph H. Turner, editor *Record;* Gus Leftwich, druggist; John R. Kirby, county clerk; W. E. Hassett, editor *Journal;* John Brand, editor *Record;* John T. Wilcoxson, banker; Jackson Timmons, farmer; Cary Trotter, livery stable proprietor; H. S. Sheets, steam sheller and thresher; Moses Slack, proprietor Senate Saloon; J. W. Clincescales, sheriff Carroll County; James A. Turner, recorder of deeds; H. Rhomberg, brewer; Samuel McCormac, assistant miller."—*The Miller*

QUICK WORK.—WHEAT HARVESTED, THRASHED, GROUND, MADE INTO BREAD, AND EATEN, ALL IN ELEVEN MINUTES.

WE have received the following interesting communication from the Hon. George Bain, the President of the Millers' National Association of the United States of America, which we have much pleasure in publishing:

Office of the Atlantic Milling Co.,
St. Louis, Mo., United States, July 19th, 1876.

TO THE EDITOR OF *The Miller:*

SIR: Enclosed find a statement duly certified of some work done by a Missouri miller. You will notice that in *eleven minutes* from the time the wheat was standing in the field it was cut (headed), thrashed, cleaned, ground, bolted, and baked into rolls. I had some rolls for breakfast this morning made from some of the same flour, and they were very nice. When in England some eighteen months ago I stated on the Corn Exchange, in Manchester, that wheat had been harvested and made into bread within thirty minutes, in Missouri. The millers looked incredulous. On meeting my friend, Mr. Lawton, at the National Convention in Milwaukee, I asked him to try it again, which he has done, and I had the result printed in the *St. Louis Republican*, from which the enclosed is extracted. The winter wheat crop of the Western and South-western States is nearly all harvested and cared for. Some damage from rains, but the yield is fully 25 per cent ahead of last year, and the quality 50 per cent better.

Very truly yours, GEORGE BAIN.

"Office of the *St. Louis Republican*,
"Monday, July 18th.

"Hon. GEORGE BAIN, St. Louis, Mo.

"DEAR SIR: We send you our time card, with authority to back it. And if the time is beaten we will put the thresh-

PREVENTION OF MILL FIRES.

BUILD your mill as fireproof as the state of knowledge of the time will enable you, under the advice of competent professional men.

Fit your premises with the best known self-acting extinguisher.

Omit not good lightning conductors in sufficient numbers, and let them be properly fixed.

Have your lighting arrangements properly considered, and do not leave it to individual hands.

Provide ready means to quell immediately any small flame as soon as it is observed—such as buckets, l'Extincteur, &c., in sufficient numbers.

Fill your rooms with machinery designed to run safely at the speed you wish to run it.

Employ good mineral lubricating oils that will not give rise to spontaneous combustion in case of neglect.

Enforce strict cleanliness.

And, finally, to the insurance offices we would say:

Insure no mill to the full amount of its value, and

Allow a fair reduction of premium on means of prevention, etc., adopted on the premises.

PORCELAIN ROLLER MILLS.

THE *Mühle*, in a recent number, gives an abridgment of a paper read by Mr. Albert Webel, steam-mill proprietor, of Gross Karlbach, on "Roller Mills," which will interest those of our readers who are watching the continental roller-mill movement. The author states: "Having used porcelain roller-mills for crushing semolina, they were lately also adopted for crushing wheat previous to grinding, whereby the millstones were relieved, and could grind larger grists, the yield of semolina was increased, and flour brands, particularly those due to rough grinding, were improved. Thus Wegmann's porcelain rollers deserve preference to any other description, because they damage the bran less and absorb less power, the latter being estimated at 1½ horse power for crushing 200 bags of wheat. These advantages are due chiefly to the surface obtained by using porcelain, which approaches in texture and roughness a fine sample of gritty flour. The economy of power with porcelain rollers is owing chiefly to this circumstance, for they require less pressure on the loose roller, to prevent slipping, than smooth rollers. Greater porosity than that of porcelain is not recommended, for it would act like a too porous stone, tearing and chipping the bran. All these reasons combine to point at the conclusion that porcelain should be preferred as a roller-mill material to metal. In conclusion, the arrangements for lubrication in Wegmann's porcelain roller-mills are highly commended."—*The Miller*.

TANNING OF TEXTILE FABRICS.

IN a communication of M. Lebrun to a German contemporary, he says it is well known that hemp, flax, and cotton tissues, being strictly cellulose, form one of the most constant organic combinations; the durability of the cellulose permits even old linen and cotton fabrics to be used up again and manufactured into paper. It is only the constant influence of humidity, heat, or air which is able to destroy this combination, by bringing it into chemical decomposition.

Not long ago it was discovered that sail-cloth, cordage, ropes, nets, etc., which were treated in tanning liquor, or tanned, were far more durable than such which were not thus treated. It was found that pieces of linen, which had been boiled during seventy-two hours in oak-bark, stretched on a wooden frame and then allowed to remain for ten years in a damp, musty cellar, showed no deterioration whatever, whereas sample pieces of untanned linen placed similarly in the cellar were almost entirely decayed. Even the wooden frame which had been treated with tanning liquor showed no perceptible change after the ten years' lapse, whereas the other wooden frames all showed signs of decomposition. Moreover, it was found that the decomposing process which had taken place in certain linen samples was likewise arrested by the very same tanning manipulation.

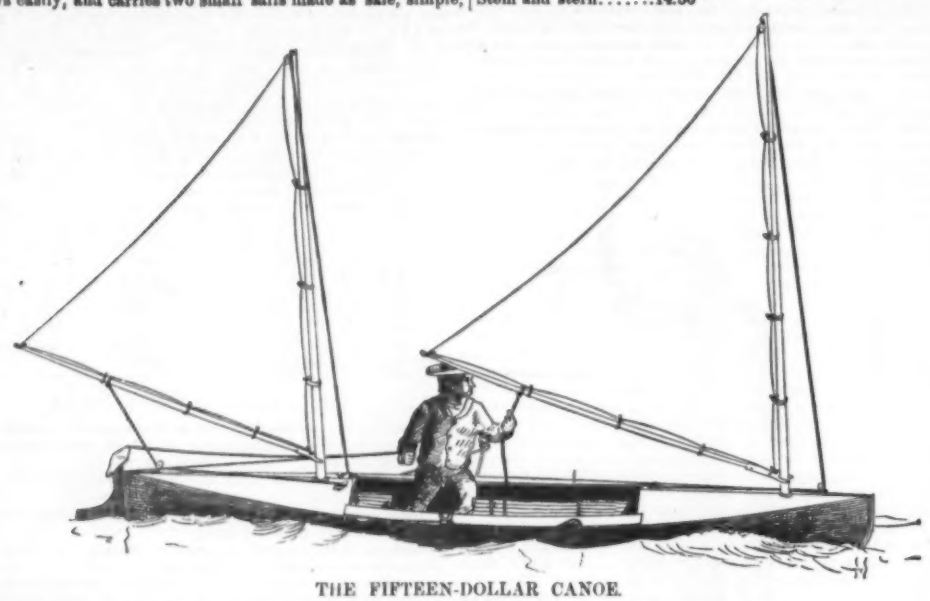
The following receipt is given for obtaining a good textile tanning liquor: Good oak-bark is boiled for half-an-hour in clean river water, after which the liquor is strained and pressed out of the settlement, and so separated from the bark. If one kilo. (2.2 lbs.) of bark be boiled as here quoted in 20 litres (4.4 gallons) of water, about 15 litres (3.3 gallons) of tanning liquor will be obtained. The tanning is taken in hand by so pouring the warm liquor over the textile fabric that the whole may be soaked with it, and then allowing the piece to remain for 48 hours in the liquor, care being taken to stir the liquor now and again. The tanned pieces are next taken out, wrung, washed, and, after wringing afresh, they are hung to dry. This tanning treatment is said to give textile fabrics an agreeable light leather color, and in this condition they are able to withstand the deleterious effects of the weather and moisture much longer than when they are not tanned. Grain-sacks treated after this fashion are rendered much more durable, and bleached, as well as unbleached linen, may be thus treated, though with unbleached goods the size must first be removed from the fabrics.

HOW TO BUILD CHEAP BOATS.

By PADDLEFAST.

NO. VII.—THE FIFTEEN-DOLLAR CANOE.—LENGTH, 13 FEET.

THIS boat is specially designed for cruising on lakes, rivers, and the smallest creeks, and even on the exposed sea-coast—in the latter case carrying ballast. It is decked, quite stiff, rows easily, and carries two small sails made as safe, simple, and handy as possible. The masts are easily removed, and spars and sails stowed out of the way under deck.



THE FIFTEEN-DOLLAR CANOE.

This boat will carry one or two persons, with provisions, water, etc., guns and ammunition. Dimensions are given for full sail, or for half sail, as desired. A centreboard is inadmissible, and a deep keel is impossible, because light draught is an object; so good sailing qualities are obtained by using the full-sized sails and a "lee-board."

Without a deck, and fitted with thwarts, this craft would be an excellent row-boat for shallow waters.

Estimated cost, fifteen dollars.

Draught, not over three inches, with one person and baggage.

CONSTRUCTION.

THIS model differs so materially from all the former that a new representation of the working drawing is shown, Fig.

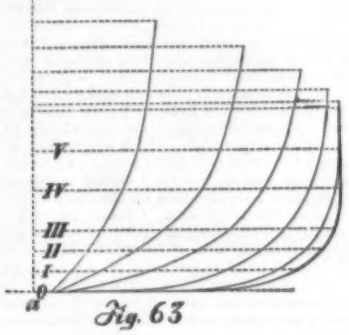


Fig. 63

63. The canoe is a double-ender, that is, having bow and stern alike; so the figure shows the series of ribs on only one side, and extending from ⊕ to only one end, those in the other section being precisely the same. The bottom is flat and coincides with line 0, and the keel is a board 5 inches wide at ⊕, and tapering to 1 inch wide at each end. The points where the curves of the ribs leave line 0 are determined by the distances in column 0, Table 1, measured from the dotted centre line *a a*, from which all horizontal measurements must be made.

Lines 0, I., II., III., are 1 inch apart; lines III., IV., V., 2 inches apart. The heights in Table 2 are measured from line 0, as before.

The ribs between ⊕ and the bow will be designated by letters, and those between ⊕ and stern by figures, as formerly. The bottom being flat, frames ⊕, 1, 2, A, B, may each be of one piece, the mould board being cut to represent the curves on both sides of the boat. Hence, in the table of dimensions of ribs, the lengths of the ribs mentioned are doubled, and the "width at lower end" will be understood to mean the width of that section of each frame which crosses the flat portion of the bottom.

Table 1.

	0.	I.	II.	III.	IV.	V.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
Rib ⊕	8.5	13.3	14.88	15.22	15.5	15.5
Ribs A and 1	15.62	12.24	13.74	14.5	15.22	15.34
" B " 2	5.22	9.79	11.54	12.66	13.9	14.5
" C " 3	1.7	5.92	8.24	9.96	11.66	12.56
" D " 4	1.3	3.44	5.26	6.58	8.5	9.4
" E " 5	.85	1.64	2.8	3.90	4.46	5.32

Table 2.

Rib ⊕	9. in.
Ribs A and 1	9.32 "
" B " 2	9.96 "
" C " 3	10.92 "
" D " 4	12.12 "
" E " 5	13.40 "
Stem and stern	14.56 "

Table 3.

Rib ⊕	15.5 in.
Ribs A and 1	15.38 "
" B " 2	14.86 "
" C " 3	13.5 "
" D " 4	10.66 "
" E " 5	6.26 "

Dimensions (*Fig.* 36).

f	14.57 in.
g	8. "
l	4.8 "
k	14. "
m	14. "
n	1.8 "
Length of keel on lower edge	12 ft. 8.6 "
p	1. "

Diagram 7.

F	1.6 in.
G	1.6 "
u	.5 "
e	.5 "
w	2.24 "
Width of G at junction with F	.5 "

The stern-post has no curve on either edge. An apron is placed above the stern deadwood as in the bow.

Frame E is	11 in. from stem.
" D "	12 " " frame E.
" C "	13 " " " D.
" B "	14 " " " C.
" A "	14 " " " B.
" ⊕ "	14 " " " A.

And the same distances for the other half of the boat.

Cross-section of keel at

	Rib ⊕, Diagram B.	Ribs A and 1, Diagram B.	Ribs B and 2, Diagram B.	Ribs C and 3, Diagram D.	Ribs D and 4, Diagram E.	Ribs E and 5, Diagram E.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
a	...	...	...	.1	.2	.35
b	5	4.8	4.2	3.6	2.8	2.
c	5	4.8	4.2	3.4	2.4	1.3

Dimensions of Ribs.

	Length.	Width of lower end.	Width of upper end.	Thickness throughout.
	Inches.	Inch.	Inch.	Inch.
⊕	52	.8	.5	.5
A and 1.	52	.8	.5	.5
B and 2.	50	.8	.53	.5
C and 3.	33	.7	.6	.5
D and 4.	22	.7	.65	.5
E and 5.	18	.6	.73	.5

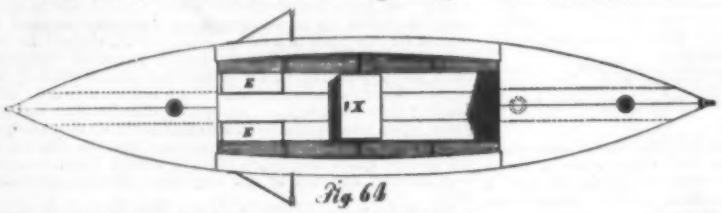


Fig. 64

Bevels of upper ends.

⊕	0. in.
A and 1	0. "
B and 2	.03 "
C and 3	.1 "
D and 4	.15 "
E and 5	.23 "

Fig. 64 is the deck plan. The outriggers carrying the rowlocks are seen on both sides. X is a simple movable bench, being handier than a thwart. E E are sections of ceiling, made movable to permit bailing.

The deck is canvas, stretched on the framework shown in Fig. 65. W is the usual gunwale, made 1.8 in. deep and 1.3 in. thick. The ends of the deck-beams are let into it about .8 in., making beam-ends and gunwale flush with the upper streak N. The slope of beams 4 and 5 is 4.5 in.; that on the others decreases toward bow and stern, so that if a board is set edgewise resting on the stem and the peak of beam 4, it will also touch beams 1, 2, and 3. The beams are cedar, .5 in. thick, 1.2 in. deep at ends, and 2.5 in. deep at peak.

Beam 1 is	.6 in. abaft bow.
" 2 "	1.5 " " frame D.
" 3 "	2 " " " C.
" 4 "	.1 " forward frame B.
" 5 "	1 " abaft " 3
" 6 "	2 " forward " 3
" 7 "	2 " abaft " 4
" 8 "	6 " forward stern.

D D (Fig. 65) are two ¼ in. cedar boards, each 4 in. wide, running from beam 4 to the bow, and from beam 5 to the stern. They are nailed upon the tops of the aprons, and made flush with both gunwales and the stem and stern pieces. The ends of gunwales are to be finished as heretofore. Beams 4 and 5 are made deeper than the others, and the ends of boards D D let into them. Boards D D need not be let into the others.

Of course the masts should be "stepped" before completing the deck. If full sail is spread, the foremast should be 1 ft. 10 in. from bow, the mizzen mast 3 ft. abaft ⊕; if but one sail is used, the mast should be 5 in. forward of frame B. The mast-holes are cut in boards D D (Fig. 64), half a circle in each board.

Sew breadths of duck together, making two roughly shaped pieces to cover the boat from bow to beam 4, and from stern to beam 5. Less material is consumed by placing the breadths across the boat. After securing the cloth by a few tacks on boards D D, stretch it tightly, fold the edges under, and tack it upon the outside of the upper streaks, the outer sides—not the edges—of beams 4 and 5, and crossing boards D D near their ends. Copper tacks should be used.

Next, boards B B (one of which is shown in Fig. 65), .6 in. thick, 4 in. wide, with a slope of 1 in 5, are laid with their ends on frames 4 and 5, and their outer edges covering both gunwale and upper streak. They are nailed to the beams, and at intervals to the gunwales, and supported at frame ⊕ by a small iron brace (Fig. 65).

Cut the mast-holes through the canvas, and tack round them. Then to bind together boards D D, screw a flat iron ring, bent to fit the slopes, round the aperture. (See Fig. 64.)

Figs. 66 and 67 represent one of the outriggers. The iron rod A (Fig. 67) lies in a plane at right angles to the boat. It is screwed to the inner side of the gunwale, before the beam B (Fig. 65) is put on, 2 in. forward of frame 1; its lower end is bent toward the stern and screwed to frame 1. The upper or outer end is bent back and made wide enough to drill a hole downward to admit the shank of the rowlock. The rowlock is secured at *d* by a peg or nut. To the extreme end of the rod B is welded, and screwed at its other extremity to the outside of the upper streak, near the top. Rod A should be quite stiff, as it bears the whole weight of the oar; rod B should be light. The section of rod A below the gunwale may be about 5 in. long; the length of rod B should be about 13 in. Sculls, 8 ft. long.

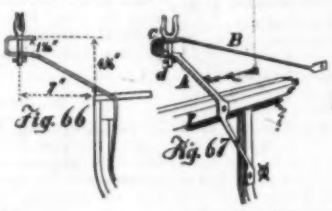


Fig. 66 Fig. 67

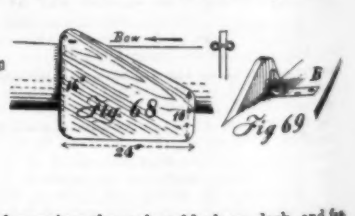


Fig. 68 Fig 69

Whether one person or two intend to cruise in this boat, only one can row; but if designed for two voyagers, the rowlocks should be put farther forward, about at frame ⊕.

The rudder should be 14 in. wide for full sail, and fitted with a yoke.

Dimensions for full sail: Foresail, height on mast, 9 ft.; length on boom, 6 ft. 8 in.; rise, 16 in. Mizzen sail: height on mast, 7 ft. 4 in.; length on boom, 5 ft. 4 in.; rise 14 in. Both are leg-o'-mutton sails, raised by halyards and attached to hoops on the mast. Booms with jaws are best, and the sails bent upon them, as in Fig. 26. Foremast, 10 ft. 7 in.

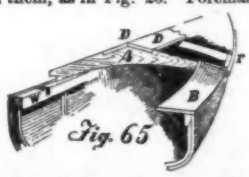


Fig. 65

long, 2 in. diameter at butt, 1 in. at top. Mizzen-mast, 9 ft. long; diameter, 1.7 in. at butt, .9 in. at top.

Dimensions for half sail: One foresail, size of either of the foregoing, as desired; mast 5 in. forward of frame B. Beating to windward is impossible with this sail, and no leeboard is needed. Width of rudder, 12 in.

To sail well the boat must be furnished with both sails and a leeboard. Fig. 68 shows the leeboard in proper position, as it should float when partially submerged; but if the buoyancy of the wood causes it to rise, a lead or iron weight let into the board at its aft end will obviate the difficulty. The proper direction of the grain is indicated, and an iron strap on the forward edge.

Fig. 69 indicates the only manner of fastening. B is the board already described in Fig. 65. A bolt is run through the upper corner of the board, and furnished with rings at each end. This bolt should turn easily. Every time the boat "comes about," this leeboard must be changed from one side of the boat to the other, to keep it always on the lee side. A hook (Fig. 69) must be provided on each side of the boat of course, about 1 ft. forward of frame ⊕.

The cut of complete boat at the head of this description shows the fore halyard running through a block on deck, and fastened to a cleat near the cockpit; the mizzen-sheet also running through a deck block, and attached to a cleat near the mast, though in gusty weather it should be held in the hand with the other sheet. Diameter of cordage ¼ in.

The weight of anchor should be about 12 lbs. The cable should be hemp, about .5 in. diameter, and length governed by the waters in which it will be used.

The seam under board B (Fig. 65) should be caulked. If the canvas is stretched sufficiently, and painted, and the tacks placed ¼ in. apart, the deck will be tighter than if of wood.

This boat, if submerged, will easily float with one person sitting in it, so that no air-chambers are needed to insure safety.

It is very desirable to galvanize all iron work used.

All necessary information omitted here may be found in previous numbers. For rough waters about 75 lbs. of ballast would be useful, further information in regard to which will be given in our next.

A yacht will be next described.

LESSONS IN MECHANICAL DRAWING.

By PROF. C. W. MACCORD.

No. XX.

(Continued from page 604.)

As there is nothing, perhaps, which goes farther in conveying a clear idea of a new process, or a new application or a modification of an old one, than a comparison of its effects on two similar subjects, we have, in Figs. 175 and 176, shown this operation performed on the same hexagonal prism before employed; but we have omitted all the lines of construction, and all the "guiding lines," as they are sometimes called,

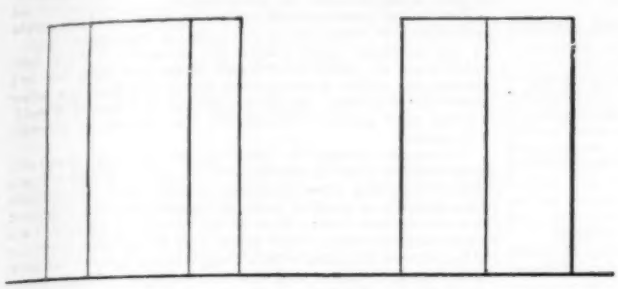


Fig. 175.

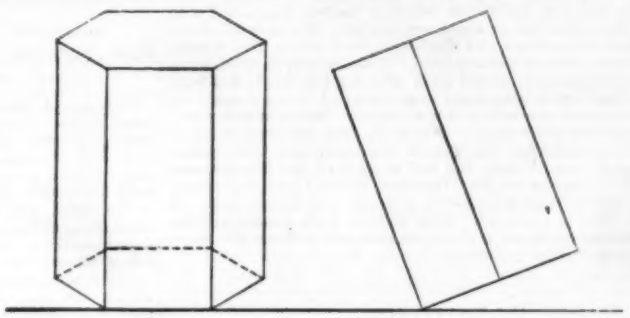


Fig. 176.

which connect one view with another, because by this time they should be unnecessary—if the student finds the least difficulty in tracing the relation between these views, or in following mentally the steps of the process by which the second group is derived from the first, let him take his instruments and make the construction for himself. If he can not do that there is something wrong somewhere: either he has failed to make himself thoroughly acquainted with what has preceded, or the preceding instructions themselves are erroneous—which latter proposition we are not disposed to admit.

We have before made use of the illustration, that if we were to slip the prism shown in Fig. 176 into a tin tube of just the right size, the edges of the prism would be lines on the surrounding cylinder. The drawing of such a cylinder when its axis is vertical, was shown in Fig. 145: now, how shall we draw it if the axis is inclined? The illustration just made use of may serve as a hint; for the six edges of the prism are six lines in the cylinder, and the six angles of the base of the prism are six points in the circular base of the cylinder. If the prism had had more sides, we should have had more points in the base, and it is clear enough that if we can draw the base of the prism when inclined, the curve which passes through all the points at the angles of the base, must be the representation of the circle which circumscribes the base. And it would not make any difference, in drawing this curve, whether the prism were a *regular* one or not: its sides might be of all sizes, so long as the edges were equally distant from the centre, so that they should just lie in the surface of the cylinder.

Now we need not suppose any prism to be there at all: all that we need is to have a certain number of points in the circumference of the base, and to be able to find their representations or projections in a new position of the cylinder, and this we have explained how to do. The points that we have dealt with, to be sure, have been thus far supposed to be the ends of straight lines; but it certainly can not affect our mode of operation if we suppose them to be anywhere on a curved line instead.

The application of this is illustrated in Figs. 177 and 178. The first is simply a drawing of the cylinder just like Fig. 145, and the second represents it with the axis inclined, the upper end being farther to the right than the lower, but at the same distance from the observer. That is to say, the cylinder has been turned about a line perpendicular to the paper in the front view of Fig. 177, the relation between these two drawings being exactly like that between Figs. 168 and 169; so that our first step is to copy that front view.

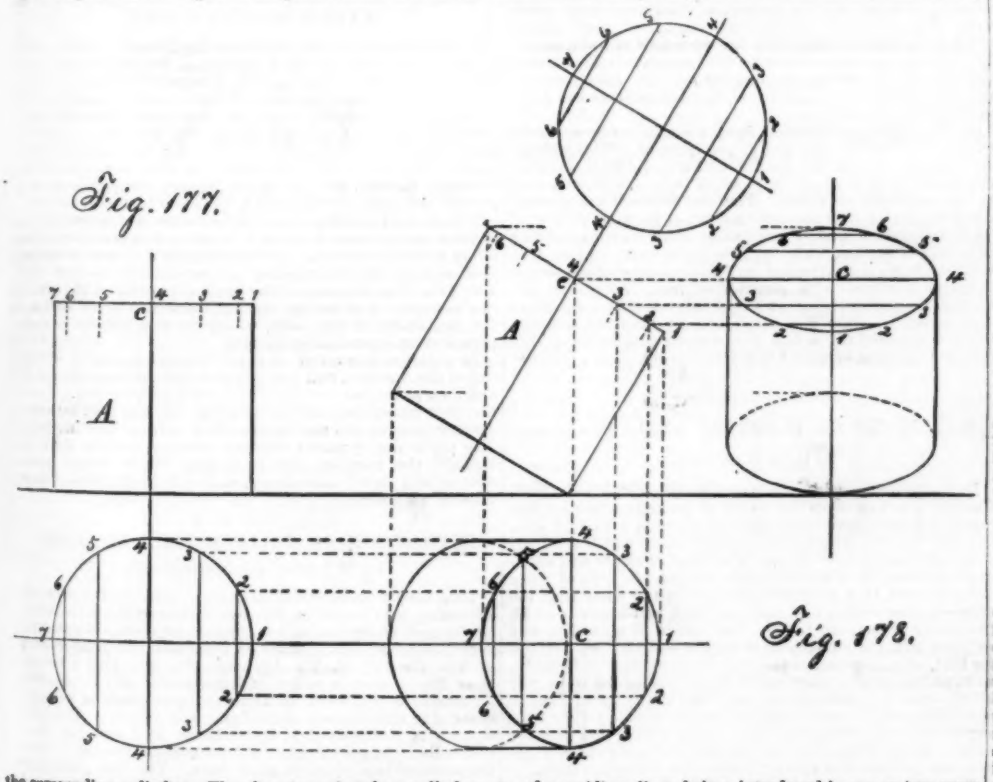


Fig. 177.

Fig. 178.

The top view of Fig. 177 has various points numbered, beginning with 1 on the extreme right; and for the sake of simplicity, the spacing is the same in the upper and the lower half of the circle, so that 2 2, 3 3, 4 4, etc., are not only on the circumference, but also at the extremities of straight lines, which are parallel chords of the circle.

Now, considering the upper base of the cylinder only, the circle is represented in the front elevation by the upper line of the rectangle: and each point numbered in the top view must have its representation in some point of this line; so, projecting those points perpendicularly upward, we have in the front elevation a corresponding series of numbered points, 1, 2, 3, etc., the guiding lines being introduced in one or two cases in the figure.

It was not necessary for us to divide the circumference in the top view into equal parts: we have, however, done so in this instance, for the express purpose of pointing out that when it is done, the spaces 1 2, 2 3, etc., in the front elevation are *not* equal.

But whatever these divisions are, we transfer those thus obtained in the front view A, to the copy of that view, A, of Fig. 178. Then to construct the top view, we proceed just as we did in drawing the prisms under the same circumstances. Thus the point 1 must be perpendicularly under 1 in view A just made, and it must also be as far from us as 1 in the original top view; and the same reasoning is true in regard to the points 2, 3, etc. Consequently we have only to draw with the T-square a horizontal through 1 in that top view, and with the triangle drop a perpendicular upon it from 1 in the new front view: the intersection gives 1 in the new top view. In the same manner we proceed with the other points in their order. In this way, it will be seen that the lines 2 2, 3 3, etc., are of the same length in the original top view and in the new one; which, of course, should be so, since they measure distances from the observer, or thicknesses, which, by the conditions of the change in position, are not altered. But they are nearer together in the new view than in the old, which is also as it should be, since the line 1 7 is foreshortened by being inclined.

The point marked *c* in all the views here given is simply the centre of the upper base, which appears in all at the intersection of the lines 1 7, 4 4; and it is clear that it ought to do so, since, in fact, it is the intersection of the two diameters so marked in the original top view, and any projection of either line must contain the projection of every point of that line.

The lower base is exactly like the upper one, and we might find its new projection in the same way; but it is not necessary to do it, since we may copy the curve of the upper one after we have drawn it, first determining the four principal points as indicated by the guiding lines.

The curve which we obtain in this way is an ellipse, of which *c* is the centre, 4 4 is the major axis, and 1 7 the minor axis. Consequently, one may say, we may draw it as such at once, without the trouble of following these various points around in their changes of position. This is very true as a matter of fact; but it is nevertheless preferable to construct it in the manner here explained, as an exercise in the application of principles and as practice in a mode of operation which will be found applicable to cases in which the curves are not definite mathematical ones, for which we have various methods of construction. What we are now aiming at, is an explanation of the drawing of all objects under certain assumed conditions; and by following the process described, one may become able to make the projections correctly, and to know why they are correct, without knowing what an ellipse is.

In the original position of the cylinder, no third view was given, because it would be precisely like the front view: in the new position, it is pretty definitely determined by the front and top views that the object is a cylinder, so that no view from either the right or the left is really necessary. But for the sake of practice, it will be well for the student to construct such a view, which we have given, the numbers corresponding with those in the other views: we leave it for him as an exercise without further explanation.

Were this inclined position of the cylinder for any reason desirable in a working plan—as it might be were it the actual position in the whole of which it is a part—we might save the trouble of making two drawings, by simply introducing a view looking perpendicularly against its upper base as it is, which is shown at B. This view would be precisely the same as our original top view; and by marking on it the points 1, 2, 3, etc., and projecting them back upon the upper base in the inclined front view, as indicated, it would answer just as well for all the purposes of constructing the remaining view or views required.

PRINTING WITH ARTIFICIAL ALIZARINE.

By J. DEPIERRE.

IF two colors are printed one above another, there is produced a third, compounded of both, and, if it contrasts with its two components, it is termed a conversion-color. Such colors commonly arise on printing with alizarine. They are not merely readily produced, but new effects are obtained which were unknown before the introduction of this color. I will mention a few cases of conversions which are useful in practice. On a former occasion I mentioned acetate of alumina, which, if printed under or upon alizarine violet, gives a rose when steamed, whilst the white remains colorless. If it is desired to obtain the same effect by dyeing, after all the operations necessary for the production of a madder violet, a discharge with oxalic acid is printed in, the pieces carefully washed, and then padded with aluminate of soda.

In a similar manner a conversion red can be produced with catechu brown; if catechu is introduced into the mordant, chromate of potash is printed in, and the rose is finally produced in the common manner. If an acetic solution of catechu is added to the alizarine steam-rose, and the goods steamed, the rose appears little hanged after soaping, and the catechu scarcely fixed at all. But if chromate of potash, or especially a soluble salt of copper, is printed over such a steamed rose, the catechu is fixed, and conversion takes place, the white being unchanged. The copper salts yield better results, since chromate of potash requires steaming, whilst if the copper salts are used it is sufficient to hang out to oxidize in the air.

The double rose effects can not be obtained as well with alizarine as with madder dyeing. A certain depth of shade can not be exceeded, as the whites are very easily soiled.

Double roses are obtained when a pattern is printed with acetate of alumina, fixed and cleared, and finally rose or red is printed over it, with a slight excess of color, and the operation ended as usual.

If, instead of rose, violet is printed, garnet or puce is obtained, according to the strength of the aluminous mordant and of the violet. A little acetic acid must be added to the color, in order to promote the solution of the mordant and the precipitation of the colored lake.

On dyeing with indigo the pre-existing pattern, as well as the whites, become stained. This takes place with alizarine red. But if, *e. g.*, red is printed on, steamed, and the pieces then wetted and soaped, the result is red beneath blue. It is, therefore, indifferent whether the red is obtained with artificial alizarine or extract of madder. These dyed colors, dulled with chrome and discharged with oxalic acid, always produce white on red and blue. If oxalic acid is used, prussiate of potash is printed upon alizarine red, which has been dyed over with indigo, and passed through caustic soda. In this manner another effect is produced. The blue is destroyed, and the red remains. But if the same pattern is steamed after printing on the yellow prussiate, and then passed through caustic soda, the red is dyed or the blue becomes dull. Alizarine red may, therefore, be dyed blue after steaming and soaping, dulled with prussiate and caustic soda. A new effect is produced. Blue and red yield garnet, and the discharge produces white upon blue, and restores the red.—*Reimann's Färber Zeitung.*

ALIZARINE.

By CARL RUMPFF.

AFTER all the lighter oils used for manufacturing aniline colors are separated from coal-tar by distillation, by successive heating up to about 170° C., the temperature of the still is raised to 210°C., and thereby the important anthracene is obtained, a body which, in a state of purity, is a hydrocarbon, has the chemical formula $C_{14}H_{10}$, and furnishes the raw material for the preparation of alizarine. According to the quality of the coal used for the manufacture of illuminating gas, the tar contains from 1 to 2 per cent of pure anthracene.

The important invention of making it serviceable for the production of alizarine, resulted by accidental circumstances.

In 1868, Messrs. Graebe & Liebermann, of Germany, experimented with alizarine ($C_{14}H_8O_4$) contained in, and centuries since extracted from madder, with the view of finding improvements for its use in printing on cotton, when they obtained a compound having the chemical composition represented by $C_{14}H_{10}$. Finding this to be also the corrected formula of anthracene from coal-tar, they promptly went farther on with the right inspiration—that if alizarine from madder could be traced back to anthracene, it wanted only a practical way for introducing four atoms of oxygen into, and withdrawing two atoms of hydrogen from the coal-tar anthracene, to make it alizarine.

This correct idea was their invention. But as is often the case with such important revolutions, brought about by chemical genius, they had only broken the ice without opening the river for navigation. The processes they had adopted turned out to be impractical for cheap production in larger quantities, and only after experimenting for several years more practical processes have been found by us and others, which opened the way for the immense production it has reached already, and affect very materially the cultivation of madder.

The crude distillate is brought into the maket in a concentration of generally 25 to 30 per cent of pure anthracene. It is a doughy, pasty mass, which, besides anthracene, contains also lubricating oils of high boiling-points. In order to prepare this crude anthracene for use at the factory, or, to make it more plain, to free it from a part of the homologous admixtures which hinder the subsequent process of oxidation, it is, after previous heating, freed first from part of its oils by hydraulic pressure, and then shows 40 to 50 per cent of pure anthracene.

Through further treatment, either by means of solvents—for instance, naphtha, petroleum ether, etc.—or by sublimation, it is more purified, so as to contain from 68 to 90 per cent $C_{14}H_{10}$. For special purposes it is prepared in a more perfect state by crystallization with 95 per cent $C_{14}H_{10}$, or even chemically pure, which, by sublimation, gives beautiful crystals.

In order to produce alizarine as the ultimate product from anthracene, different methods may be adopted, either by forming bichlor-anthracene $C_{14}H_8Cl_2$, or biborm-anthracene $C_{14}H_8Br_2$, or by oxidizing anthracene with the assistance of bichromate of potassa and sulphuric acid into anthraquinone which, when chemically pure, has the formula $C_{14}H_8O_2$, and crystallizes in beautiful needles.

It is, of course, impossible for us to specify the many different methods by which the point aimed at, viz., alizarine, can be, and is, reached; but we give the following way, tested in practice, which renders it possible to obtain a clear insight into the successive development of the end product.

Both bichlor-anthracene and bibrom-anthracene, as well as anthracene chlorinated by special processes, and also the anthraquinone form when heated with anhydrous oil of vitriol a sulpho-acid (a crude anthraquinone product practically workable), which, according to its subsequent purification or treatment, furnishes a material—sulphanthraquinonic acid—for the production of alizarine, dyeing with scarlet or bluish tints.

If the sodium salt of sulphanthraquinonic acid, together with caustic soda, is heated up to a high temperature, the alizarate of sodium, $C_{14}H_6Na_2O_4$, is formed as a crude fused mass, fit for farther factory purposes. On decomposing this salt by an acid, the alizarine $C_{14}H_8O_4$ is obtained, which, carefully purified, comes into the trade as a paste of 10, 11, 15 or 20 per cent concentration.

The preparation and use in this watery state has hitherto proved to be the most advantageous and practical form of alizarine, as, if it is furnished in a dry state, a perfectly equal solution and distribution afterwards in the dyeing bath, or in the thickening for printing, would be found very difficult.

In this respect, also, is shown the essential difference of character between the alizarine colors and the aniline colors, which latter in dyeing form only a precipitate on the fibre, and are therefore not fast, especially when exposed to the influence of the light, whereas alizarine is a fast color, because it is an acid which, in combination with other mordants, by a process of oxidation similar as is the case with indigo, develops the red, violet, orange, black or brown tints in the fibre, thereby producing it fast against light and even the strongest fulling.

Alizarine crystallizes and sublimes in red needles. By a double decomposition of a solution of alizarate of potassium, or alizarate of sodium and soluble metallic salts, the corresponding difficulty, soluble alizarates, are obtained.

The most interesting, wonderful fact which will strike our minds with surprise while investigating the above processes, is that in coal-all that remains from the trees and vegetation of gigantic antediluvian forests should have been discovered a raw material, and from it a color of exactly the same chemical identity and composition as that which so far was extracted only from the root of the insignificant plant Rubia tinctorum, generally known as madder. After such success, it is quite natural that efforts have been made to go still a step farther in this direction, and that we, as well as many others, hammer already for a considerable time at the solution of another immense problem, viz., the artificial production of real indigo.

NEW PROCESS FOR PREPARING PURE NICKEL SALTS.

THE use of nickel in the arts for surfacing all kinds of metal objects is decidedly on the increase. The brilliancy without glare of nickel plating, its hardness and resistance to wear and corrosion, and its general good behavior explain why nickel-plating is coming into favor, and we can only hope that it will largely replace lacquering, the wear of which is uncertain, and lead to further industrial and artistic adaptations of iron and steel. M. Terreil's process for getting pure nickel salts from commercial nickel (reported in Quesneville's *Moniteur Scientifique*) seems worthy of attention.

Commercial nickel, says M. Terreil, is an alloy of nickel, copper, and iron, with small quantities of arsenic. The proportion of nickel in this alloy varies from 40 to 90 per cent; the alloy serves for preparing nickel salts according to the well-known method, according to which copper and arsenic are separated from acid solutions of the alloy with sulphuretted hydrogen, and the peroxidized iron is thrown down with an excess of ammonia. The result of the operation is an ammoniacal salt of nickel, from which it is not at all easy to extract the metal.

I wish to propose a new treatment of the nickel of commerce, which excludes the use of sulphuretted hydrogen and ammonia, giving a cheap and immediate yield of pure sulphate of nickel. This treatment comprises the four following operations: (1) Dissolving nickel in acids; (2) precipitation of copper by iron; (3) peroxidation of the iron, and transformation of the metals into sulphates; (4) precipitation of the iron by the carbonate of barium, and crystallization of the sulphate of nickel.

(1) Commercial nickel is dissolved by attacking it with from seven to eight times its weight of *aqua regia*. After complete solution evaporation goes on almost to dryness; the salts formed are dissolved in water, with the exception of a little insoluble arseniate of iron, which can be separated by filtration.

(2) Iron nails are introduced into the hot liquor, to throw down copper in the metallic state. This precipitation of copper is carried out very rapidly; it is complete when a nail plunged into the liquor remains white and brilliant. The copper is separated by decanting the solution on a filter; it is washed, and won by passing it under water through a wire sieve coarse enough to let through the copper while it keeps back the iron; when dry the copper is in a fit state for sale.

(3) The liquor separated from the copper only contains nickel and iron. The latter metal, present as protoxide, is peroxidized either with a current of chlorine or with nitric acid. When the iron is peroxidized, enough sulphuric acid is added to the liquid to transform the two metals into sulphates; the hydrochloric and nitric acids are evaporated off; water is added to the dry residue to dissolve the sulphates of nickel and iron. Very often a portion of the iron remains behind as an insoluble subsulphate.

(4) The iron is precipitated from the solution by means of carbonate of barium obtained by precipitation. This carbonate separates iron in the condition of a sesquioxide, forming at the same time insoluble sulphate of barium, without acting on the sulphate of nickel. The last traces of arsenic contained by the solution are thrown down at the same time with the sesquioxide of iron. Precipitation is carried out by adding carbonate of barium little by little to the warm liquor; it is complete when the carbonate no longer causes effervescence or becomes coated with peroxide of iron. After this last reaction the pure sulphate of nickel only remains in solution; it is separated from the precipitate by filtration, and the liquor evaporated till a film forms on its surface and allows the pure sulphate of nickel to crystallize out.

NOTES ON BLOWPIPE ANALYSIS.

By H. B. CORNWALL.

IN a note published in the *American Chemist*, March, 1872, I stated that Van Kobell's iodide of potassium and sulphur test for bismuth gave also a marked reaction with lead compounds. The characteristic yellow sublimate which it affords with lead compounds is nearly as volatile as the real sublimate obtained by it with bismuth compounds, both of them being formed at a greater distance from the assay than the simple yellow coatings of oxides of lead and bismuth which frequently accompany them. The iodide of potassium and sulphur mixture constitutes a simple and very delicate test for lead, even in presence of a very large amount of bismuth, as experiments will show, and I direct the students to rely chiefly upon it; remembering only that the iodide of lead (?) sublimate is much more volatile than the simple yellow coating of oxide of bismuth or lead, which always lies near the assay. A few precautions are necessary in using the mixture as a test for lead, and also for bismuth to a certain extent.

Mercury compounds will often afford a yellow, sometimes a reddish sublimate with the mixture; sulphide of arsenic in large quantities, a yellow sublimate; sulphide of antimony, an orange, sometimes a reddish sublimate; cadmium compounds the yellowish brown coating of cadmium oxide, which might mislead beginners: all of these can be removed by a preliminary treatment with a moderate oxidizing flame, to such an extent as not to interfere with the lead or bismuth reaction, and they should be so removed when present in large quantities. Finally, some tin compounds yield a yellowish sublimate with the iodide mixture, but it is very near the assay, and quickly becomes white on continuing the blast. These facts have partly been brought to my notice during practice with classes, and therefore will be of interest mainly to beginners, who are most liable to be deceived by the reactions given. The mixture is, however, highly to be recommended in testing for lead, having given indications of that metal in bronze and cadmiferous calamine, when all other blowpipe tests failed; the lead in the bronze was overlooked by an experienced chemist.—*American Chemist.*

PROCESS FOR FINISHING BRONZE AND BRASS ARTICLES.

M. F. DIETLEN'S process for the above purpose is as follows: When the articles, such as those used in gas apparatus, are completed, they are slightly re-heated to get rid of all trace of grease. If that is not possible on account of the solder or their form, the cleaning is performed by brushes impregnated with potash or soda lye, and the articles are dried with very dry sawdust. After this they receive a dull coating, and the projecting parts are polished with the burnisher. For polishing, grease should not be used, but simply pure water. Lastly, the articles should be brushed with chalk, subjected to flame of charcoal or alcohol, and varnished with a palette pencil or by immersion.

For the dull coating equal parts of sulphuric acid and nitric acid should be used, care being taken to put a piece of zinc in the mordant liquid during the operation. When the articles are of bright or greenish brass they must first be colored red, which is easily done by heating them in a bath of tartrate of potass. After the coating they should be well washed with plenty of water, lest they should be covered with spots.

The varnish is made by dissolving 65 grammes (2¼ oz.) of gum lac of a clear brown color in a mixture of half a litre (rather more than three quarters of a pint) of alcohol, and the same quantity of spirit of wine, and adding four soup spoonfuls of turmeric flour. The whole should be exposed in a warm place for twenty-four hours, and filtered through felt. If the articles are dried a little every time a layer of varnish is deposited, the latter will form a covering of a bright gold color, which will not be injured by being often handled.—*Dingler's Polytechnisches Journal.*

DEODORIZING PETROLEUM.

IT has been very generally supposed that to attempt to deodorize petroleum was much like trying to wash a black man white, and certainly all the attempts hitherto made have ended in failure. It would seem, however, that Mr. E. E. Johnson, of Manchester, has discovered a method of treating petroleum and other mineral oils, by which he not only purifies but deodorizes those useful hydrocarbon liquids, and, what is more, effect that desirable object in a simple and inexpensive manner. Chloride of lime is first introduced into the cask or other receptacle containing mineral oil or spirit, in the proportion of about 3 ozs. of chloride of lime, more or less, to each gallon of the liquid, according to the degree of its impurity, and thus chlorine gas is evolved in the midst of the oil or spirit. If necessary the evolution of the chlorine gas may be assisted by pouring in hydrochloric acid, when either by agitating the receptacle or by the application of an agitator or stirrer, the contents of such receptacle are agitated so as to bring the whole of the liquid into intimate contact with the chlorine gas the oil or spirit is then passed into another inclosed vessel, containing slaked lime, which, having an affinity for the chlorine gas, soon absorbs the same, removing all objectionable traces of such gas, and leaving the mineral oil or spirit sufficiently deodorized and purified.

If a further degree of purity or decolorization is required, the mineral oil or spirit is afterwards passed through charcoal.

WATERPROOFING PAPER.

THE substance used for waterproofing is white paraffin, and it is applied by means of a cylindrical rotating brush, one side of which acts on the paper as it is caused to travel past it, while the other side is pressed against a block of paraffin. If the pressure is properly regulated the brush takes off from the block the right quantity of paraffin, and then, as it rotates, distributes the paraffin evenly over the surface of the paper. The other side of the paper is afterwards treated in the same manner, and the paper is then completely waterproofed and ready for use, and requires no further treatment.

The block of paraffin is carried in a slide, which rests on an inclined table, whose lower end is pivoted as near as may be to the axis of the brush. A cord is attached at one end to the slide, and passing over a pulley has attached to its other end a weight. The pressure of the block of paraffin on the brush can be regulated either by varying the weight or by altering the inclination of the table, which for this purpose is supported at its upper end by a screw.

In waterproofing a roll of paper the reel is carried at one end of the machine, and the paper is led over a guiding roll and then passes between the brush and a pressing roll. From thence it passes over another guiding roll, and then between another pressing roll and brush, which acts on its other face. The paper finally passes between drawing rolls to draw it through the machine, and it is then either wound upon another reel or cut into sheets, as may be preferred.—*Paper Makers' Circular.*

EXTRACTION OF GALLIUM FROM ITS ORES.

By M. LECOQ DE BOISBAUDRAN.

THE blende is dissolved in *aqua regia*, and pieces of sheet-zinc are placed in the liquid, and withdrawn when the escape of hydrogen has greatly subsided, but is still perceptible. In this manner is separated the greater part of Cu, Pb, Cd, Ir, Tl, Ag, Hg, Se, As, etc. To the clear liquid zinc is added in large excess, and it is boiled for several hours, when an abundant precipitate is formed, containing alumina, sub-salts of zinc, and gallium. This precipitate is re-dissolved in hydrochloric acid, and the solution boiled again with zinc. All the gallium present is thus concentrated in a liquid of small bulk. The last gelatinous precipitate is dissolved in hydrochloric acid, acetate of ammonia is added, and the solution treated with sulphuretted hydrogen. This operation is repeated for the complete removal of the alumina. The hydrochloric solution of the white sulphides is precipitated fractionally with carbonate of soda, when the gallium is found concentrated in the first portions deposited. The spectroscope indicates the point at which it is necessary to stop. To complete the separation of the zinc, the oxide of gallium is dissolved in sulphuric acid, and then supersaturated with ammonia in excess. The gallium which remains in the ammoniacal solution may be expelled by boiling to expel free ammonia, destroying the ammoniacal salts with *aqua regia*, and fractional precipitation with carbonate of soda. The pure oxide of gallium precipitated by ammonia is dissolved in potassa and submitted to electrolysis, when gallium is deposited on the negative platinum electrode. The positive electrode, likewise of platinum, should be larger than the negative. Five or six Bunsen elements are sufficient to decompose 20 to 30 c.c. of the concentrated solution. On placing the negative electrode in cold water, and bending it,

the gallium is easily detached. The author has sought for gallium in the following substances:

A. *Rich Substances.*—Black blende from Beusberg (specimens sent by the Vieille Montagne Mining Co.); yellow transparent blende from Asturias; brown blende from Pierrefitte (Pyrenees).

B. *Rather Poor Substances.*—Powdered zinc from the Vieille Montagne; zinc dross from Corphalie (?).

C. *Very Poor Substances.*—Yellow opaque blende from Mandesse (Gard); brown blende from Sweden; black brown blende from Schwarzenberg, in Silesia; blende in rods from Nouvelle Montagne. No gallium was found in the following:—Ribbon blende from Vieille Montagne; tuty from Corphalie; galenas from Pierrefitte and elsewhere; metallic zinc from Vieille Montagne, as used at Cognac for building purposes; calamines from Sardinia and Le Gard; commercial hydrochloric and nitric acids.—*Comptes Rendus.*

NEW PROCESS FOR THE MANUFACTURE OF DEXTRIN.

By M. ANTHON.

AT present fecula in the separate state is exclusively employed in the preparation of dextrin, all that portion being wasted which is retained by the fibrous part of the potato or of the bran. To prevent this loss, the author recommends the use of the entire potato dried and ground after being freed from its soluble principles by washing in acidulated or alkaline water. The fecula thus obtained is sprinkled with hydrofluosilicic acid (0.5 to 1 per cent of the weight of the fecula); it is then placed in a drying-room at 38° to 44° till there is no further loss of weight; the temperature is then raised to 70° to 75° till no loss occurs, and finally to 90°. The desiccation being thus complete, the fecula, whilst still hot, is placed in large flat sheet-iron troughs, which are introduced into large stoves heated to 100° to 125°. The transformation into dextrin is known to be complete when a sample taken out, on being cooled and moistened with cold water, adheres together in little glassy globules.—*Dingl. Pol. Journ.*

EXTRACTING MERCURY AND OTHER VOLATILE METALS FROM THEIR ORES.

By H. BERRENS, Paris.

THE object is to precipitate or condense all the mercurial vapor that the uncondensable vapors (which accompany it from the furnace) alone shall escape into the outer air, while the vapor of mercury, together with such substances as water, tar, sulphurous acid, pyroligneous acid, or other condensable vapors, shall be found precipitated in the condenser. The sulphurous acid combines with the oxygen of the water, and is precipitated in the form of sulphuric acid.

IMPROVED METALLIC ALLOY.

By A. LE MARQUAND, Paris.

THE invention relates to a new white metallic alloy or white metal, which is not liable to oxidation, composed of the following ingredients:—

Pure copper	750	parts.
Pure nickel	140	"
Oxide of cobalt	20	"
Tin	18	"
Pure zinc	72	"
	1,000	

OSMIUM.

By MM. STE.-CLAIRE DEVILLE and H. DEBRAY.

OSMIUM as obtained by the authors has a fine blue color, shaded with gray. It forms small crystals, either cubic or rhombohedric, closely bordering upon the cubic form. It is harder than glass, which it scratches with ease. It is the heaviest body known, its specific gravity being 22.477. Crystalline osmium is obtained by passing the vapor of osmic acid, repeatedly rectified, over pure carbon. The sesquioxide of osmium is frequently deposited in the tube in crystalline scale of a fine coppery-red. It is permanent in the air, and consists of—

Osmium	89.13
Oxygen	10.87
	100.00

ABSORPTION OF FREE NITROGEN.

By M. BERTHELOT.

THE author finds that free nitrogen is absorbed at ordinary temperatures by organic compounds under the influence of the electric *effluve* (silent discharge). He insists on this new cause of the fixation of atmospheric nitrogen in nature. It produces condensed nitrogenous compounds belonging to the class of the humic principles. However limited may be the effects at each moment, and on each particular spot of the earth's surface, they may nevertheless become considerable, in virtue of the extent and continuity of a reaction universal and never ceasing.

ARTIFICIAL INDIA-RUBBER.

A CHEAP and useful substitute for India-rubber is, it is said, prepared by mixing a thick solution of glue with tungstate of soda and hydrochloric acid. A compound of tungstic acid and glue is precipitated, which, at a temperature of 86° to 104° F., is sufficiently elastic to admit of being drawn out into very thin sheets. On cooling, this mass becomes solid and brittle, but on being heated again, soft and plastic. This new compound can be used for many of the purposes to which rubber is adapted.

ASBESTOS IN NEVADA.

IN Nevada there is a great abundance of this mineral. The asbestos lies in the crevices of the rock over a great extent of country, looking, where exposed to the atmosphere, somewhat like oakum. The streaks of the mineral are from six inches to two feet in width, and in many instances these small veins can be traced for two hundred or three hundred yards.

ATOMIC CONSTITUTION OF BODIES.

By M. DE ST. VENANT.

THE author concludes that we can not, without placing ourselves in contradiction with the totality of celestial and terrestrial phenomena, regard atoms as corpuscles formed of hard and continuous matter, but that there is nothing contradictory in considering them as material points endowed with all the properties, save extension, which we observe in visible and tangible bodies.

TRANSPARENCE OF FLAMES.

By MM. JAMIN, PUISEUX, and E. BECQUEREL.

M. ALLARD finds that the luminous intensity of the flames of lamps with concentric wicks increases more rapidly than the consumption of oil, and equally with the visible surface. The mean value of the coefficient of the transparency of flame, for a thickness of 1 centimetre, is expressed by the number 0.80.

METALLIZATION OF ORGANIC BODIES FOR GALVANIC DEPOSITS.

By M. P. CAZENEUVE.

THE author saturates the bodies in question with alcoholic nitrate of silver, which is then reduced by the solar light, or preferably by means of mercurial vapors.

PURPURIN.

ACCORDING to F. de Lalande's French patent, purpurin may be obtained as follows: 100 parts alizarin and 100 of dry arsenic acid are heated with 1000 parts of sulphuric acid to 150°, until a sample taken out gives a deep red color with soda. He then dilutes with 30 volumes of water, heats and filters. The residue is used for dyeing. Instead of arsenic acid may be used antimonic acid, peroxide of manganese, or stannic acid.

CEMENT CASKS.

M. BOLLERT, near Zurich, in 1871, first attempted to substitute casks made of cement for the usual wooden ones for storing wine, his cellar being moist and destructive to wood. The success of the experiment was such that all the wooden vessels have since been thus replaced. Among the advantages ascribed to the cement casks, in addition to diminished cost of construction, are great economy of room, great solidity, without expense for repairs, diminished loss of the contents, and lightening of the work in the cellar. New wine is filled into them without hesitation, as no injurious effect is noticeable. The general plan of construction was, first to coat suitably selected portions of the cellar walls roughly with cement-mortar, and then with the best pure Portland cement, and to form the other portions of the vessels by pouring the material into suitably constructed wooden moulds. He succeeded in rendering the finished vessels deceptively similar in external appearance to the wooden ones. After the interior was sufficiently hardened, they were filled with water for ten days to ascertain whether they were tight, and also to extract the caustic ingredients of the cement. The latter object was not, however, fully accomplished in this way, as the wine lost almost all its acidity in a few days, but soaking with a solution of carbonate of ammonia and subsequent rinsing with water proved much better, and the objection on this account was ultimately completely removed. Others have also employed them since then, and their introduction by the wine-growers on the Mosel is also contemplated.

AIR-BAGS FOR RAISING SHIPS.

PROF. ST. CLAIRE, of Edinburgh University, in 1785 proposed the use of air-bags for the purpose of raising sunken ships. In 1864 air-bags were first practically applied for raising a steamer sunk in the lake of Boden; in this case the bags, owing to some defect, gave way. The Alexandrovsky system, perfected some ten years ago, has already rendered good service to the Government and commerce of Russia on several occasions. The bags adopted in the Russian navy, as we learn from *Engineering*, are, when inflated, of cylindrical form, measuring twelve feet in diameter and twenty feet in length. They are composed of three layers of the thickest canvas saturated with india-rubber. Their lifting power averages sixty tons. In order to lift a vessel, several chains are drawn by divers under her bottom, and air-bags attached to the ends of each of them as near the ship's bottom as possible: the bags, being inflated by means of air-pumps, cause the ship to rise. Before pumping air into the bags, all the chains are connected in a transverse direction, so as to form one system, thus preventing the pairs of bags from sliding off from beneath the hull of the ship. As the vessel rises the surrounding water-pressure decreases, and the excess of air passes out through safety-valves.

CHROME RED.

PRINVAULT has made a communication on this subject to the Industrial Society of Rouen. If carbonate of lead is digested with a cold solution of 1 part of yellow chromate of potash in 50 parts of water, so that one equivalent of the chrome compound may act upon two of the lead, in the course of two days there is produced a crystalline deposit of basic chromate of lead. If the supernatant liquid is boiled it gives off carbonic acid, and decomposes a part of the red precipitate, which takes a violet-red color, whilst the liquid turns yellowish. This violet-red precipitate is too dull for use, but if it is washed and treated with 4 per cent of its weight of dilute sulphuric acid (diluted to the extent of 1 part in 100 of water), the acid being added slowly with constant stirring, and afterwards neutralized with dilute soda, there is formed a mixture of sulphate and basic chromate of lead, the color becoming a fiery scarlet. Nitric or acetic acid may be used instead of sulphuric, but not muriatic. Twenty-five parts of neutral carbonate of lead were digested with 10 parts yellow chromate of potash, previously dissolved in 500 parts of water, digested for two days in the cold, boiled for half an hour, filtered, the precipitate washed, and then treated with 1 part of sulphuric acid, diluted with 100 parts of water. According to trials made, this red cannot be fixed with albumen, on account of its crystalline structure. Dr. Reimann hopes that it may be produced upon the fibre, as is the case with chrome-orange.

BLACK ANILINE INK.

DISSOLVE one part of commercial nigrosin, soluble in water, in 80 parts of water. The solution possesses a beautiful purplish-black color in the glass, and appears deep black at once on paper. It flows very freely, and, since it has a neutral reaction, does not corrode the pens, nor does it become mouldy, and when dried up it can be rendered as available again by simple addition of water. Unless it is too concentrated, in which case water should be added, it does not rub off when dry, and but slightly when wet. Acids only impart a bluish tint to the writing, without effacing it.

YELLOW.

ROSENSTIEHL has obtained a coloring matter in yellow metallic lamellæ by acting upon dry artificial alizarin with nitrous acid. With alumina it dyes yellow, and with iron mordants a red-violet, both which colors can be brightened with boiling soap lyes. It dyes best in distilled water or with addition of acetate of lime. Rosenstiehl considers it as nitro-alizarin.

PERSIAN RED.

M. PRINVAULT has communicated to the Industrial Society of Rouen a process for obtaining a scarlet, the shade known as Persian red, from the chromate of lead. If carbonate of lead is digested with a cold solution of 1 part of the neutral chromate of lead in 50 of water, so that two equivalents of the former may react with one of the latter compound, there is obtained in two days a crystalline precipitate of basic chromate of lead. If the supernatant liquid is boiled, it evolves carbonic acid, since bicarbonate of potassa is present, and is converted into a solution of potash, which decomposes a part of the red precipitate, so that it takes a violet-red color, whilst the liquid turns yellow. The precipitate is too dull to be of any value. If it is washed with water, and treated with 4 per cent of its weight of dilute sulphuric acid (1 in 100), adding the acid slowly and stirring, and then neutralizing with a dilute solution of soda, there is formed a mixture of sulphate and of basic chromate of lead, the color passing into a fiery vermillion. The quantity obtained is about equal to the carbonate of lead employed. According to M. Prinvault, nitric or acetic acid may be used instead of sulphuric, but not hydrochloric. The proportions he employs are 25 grammes neutral carbonate of lead, with 10 grammes neutral chromate of potassa. He digests two days in the cold, boils for half an hour, filters, washes the precipitate, and treats it with 1 grm. of sulphuric acid diluted with 100 grms. of water. The new red can not be fixed with albumen on account of its crystalline texture. It may, however, be possible to convert chrome orange into Persian red upon the fibre.—*Reimann's Farber Zeitung.*

FATTENING OYSTERS.

SALT oysters, on being transferred to fresh water, are "fattened" in the course of two or three days; if allowed to remain longer they become lean again, and are flavorless. Prof. Persifor Frazer, of the Academy of Natural Sciences of Philadelphia, holds that this change can not be due to an increase of flesh, and attributes it rather to a simple distention of the tissues, owing to the admission into them of a greater quantity of fluid. During the oyster's period of growth on the seacoast, its tissues are constantly saturated with the ocean-brine; on removing the animal to merely brackish or to fresh water, the conditions are at once favorable for osmose to be commenced. The fresher and less dense liquids without permeates inward more rapidly than the more saline and denser liquids within escape, and the effect is to swell the tissue, as a cow's bladder half filled with air and immersed in a vessel of hydrogen is swollen, or still more nearly like the swelling of a bladder half filled with copper sulphate when immersed in water. "It is worth while to inquire," adds Prof. Frazer, "whether means could not be devised to effect this fattening while yet not depriving the oyster of the salty flavor which is its chief charm to many consumers. Perhaps an immersion in concentrated brine for several days and its subsequent removal to ocean water would suffice."

NIGHT HABITS OF FISH.

MR. W. SAVILLE KENT had in the Manchester Aquarium a number of young herrings, which were so tame as readily to take their prepared food from the hand of a keeper. But a large number of the fishes were found dead each morning, a fact which seemed inexplicable, considering their quiet behavior during the day. A night inspection, however, revealed the cause of this rapid destruction. It was found that the nocturnal movements of the herring, at least in confinement, are altogether different from their movements in daylight. In the latter case, these movements are quiet and uniform, the fish swimming around their tank in one shoal and one continuous stream. At night, on the contrary, the shoal is entirely broken up, each fish taking an independent path, and darting from one side of the tank to the other with surprising agility. It was during these active nocturnal movements that the fish struck against the rockwork of the tank and came to an untimely end; this mortality, however, was soon arrested by placing a dim light over their tank, which illuminated the outline of the rockwork just sufficiently to enable them to recognize and avoid it. With this dim light the fish still retained their active habits, and it was noticeable that during these night-hours they were more than ordinarily alert for food, dashing vigorously at any entomostracan or other minute organism that passed through the water. This circumstance would seem to explain why "drift-net" fishing for herrings can be carried on successfully only at night, that being the time when the fish rise to the surface of the water to feed on the innumerable organisms that there abound.

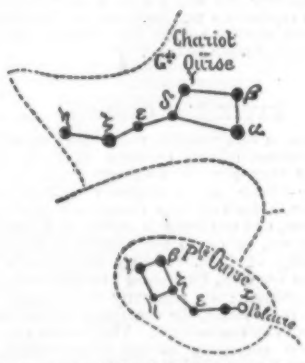
CORMORANT FISHING IN ENGLAND.

A VERY curious sport is gaining ground in England, so says the London *Daily News*. The use of cormorants for fishing purposes has been practised for centuries by the Chinese, who carefully train these birds to deliver their prey uninjured to their master instead of appropriating it to their own use, and from China and other oriental countries it has been brought to England. Cormorant fishing recalls, in a measure, the days of old falconry, with the exception that while the feats

of the trained hawks and falcons were performed in mid-air, the performances of the "sea-crow," as the French call it, take place in the water. With a ring placed around their necks to prevent them from swallowing their booty, though well-trained birds will dispense with this restraint, the cormorants plunge at a given signal into the water, and hardly ever fail to bring up a finny prize. Their broad, webbed feet, and their thin, keel-shaped body, admirably adapt them for swimming and diving, and they will often use their short, stiff wings as an additional means of propulsion. So swift are they, and so sudden their descent, that the nimblest fish can not escape them. If they seize their prey otherwise than by the head they ascend to the surface, and quickly jerking it into the air will adroitly catch it as it falls head-foremost. The appearance of a number of cormorants thus engaged, and regularly bringing their booty to their owner's hands, is a very pleasing sight. Thus employed they will continue fishing, with but little intermission, and with the occasional encouragement of a handful of the smaller fry, for several hours together. Otters, indeed, can be trained to act in a similar manner, and if this mode of fishing is likely to become at all general, it will necessitate a new reading of certain acts of Parliament. Under the salmon-fishery acts, for instance, a duty is payable on "instruments" used for the capture of salmon, and it may become a question for the lawyers whether a cormorant can properly be called an instrument if engaged in pursuit of salmon, while it is only an aquatic totipalmate bird at other times. There are, at any rate, few kinds of sport which are not open to objections from which cormorant fishing is free. Cormorants must have fish to eat, and it is no more cruel to let them feed themselves in the presence of admiring spectators than to catch the fish first of all in a net. It is even superior to the ancient falconry, since the winged prey of the hawk is a more sensitive animal than the finny prey of the cormorant, and the fish do not probably feel any pain in their ignominious descent, head foremost, into the capacious beak of their captor.

THE CELESTIAL INDICATOR.

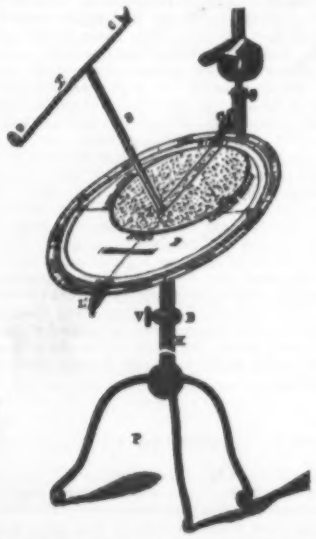
VERY many persons would with pleasure pursue the study of the heavens if they were not repulsed at the outset by the difficulty of identifying the constellations and the stars. We transfer from the columns of *La Nature* engravings and a description of the apparatus of Mauperin, which affords the greatest facilities to the curious, and enables them at once to identify any star or constellation. First we describe, as most easily found, and as necessary to the use of the apparatus, the two constellations—the Great Bear and the Lesser. By these constellations we find the polar star.



THE GREAT AND THE LESSER BEAR, INDICATING HOW TO FIND THE POLAR STAR.

The Great Bear (Grande Ourse), or the Wagon, or Charles' Wain, is easily found in the northern part of the heavens. That beautiful constellation is principally formed of seven secondary stars. Four of these form a trapeze or figure of four sides, the lines of which are not parallel. These are alpha, α; beta, β; gamma, γ; and delta, δ, and are the four wheels of the wagon when the constellation is called a wagon. The other three stars, epsilon, ε; zeta, ζ; and eta, η, are the pole of the wagon. The line $\beta\,\alpha$, in the Great Bear, prolonged in the direction of α, whatever may be the position of the constellation, will pass near a brilliant star a in another constellation, the Lesser Bear, a group smaller than the other, and placed in a position inverse to it. This star, the end of the wagon-pole, if we call the Lesser Bear a lesser wagon, is the North Star.

The apparatus of Mauperin must be so placed for observation that its meridian may be in a line with the observer and the North Star. This apparatus consists of a rod, or



rule, T, with an eyelet, O, on one end, and a crescent, (, on the other; and the observer, with his eye at the eyelet, fixes the star to be observed in the crescent at the other end. The rod is affixed with a joint to the head of the column S, and thus may traverse from the horizon to the zenith, but it can not be moved laterally without turning the column with it. The column rises from the centre of a table, which is covered with a rotary chart of the heavens. But this chart is again covered by a fixed disk with an elliptical opening, through which are seen the stars in their position at any time when the observer uses the instrument. On the circumference of the *fixed* disk are marked the hours of the day, divided into five-minute intervals. On the circumference of the rotary card are marked the months and days. When the instrument is in position, and the fixed meridian line ranges north and south, if the day and hour are brought to correspond, the opening in the upper disk shows, on the card under it, the exact map of the heavens. To move the table round without disturbing the feet, a screw, V, must be loosened at the collar B, on the pedestal of the instrument H. When the table is put in place the screw is tightened. There is still another adjustment. The inclination of the table must be regulated by the latitude of the place where the observation is taken. To effect this there is a graduated segment of a circle under the table at *f* (second figure), fixing the inclination by the

screw K. At the foot of the column S an indicator I is affixed, having two parallel lines. As the sight-rod T is moved to right or left, this indicator moves with it, and when the star sought for is found, its name and place are shown on the chart between the lines of the indicator, or alidade. Or the process may be reversed. The observer may find on the chart the stars he wishes to see in the heavens, and arranging the indicator to include them, then look along the sight-rod. This arrangement of the chart has great advantages over the old mode of holding the map of the heavens over the head. A shaded lamp at L throws light on the chart without annoying the observer, and a button, G, serves to move the rotary chart to its position. The column S marks the axis of the heavenly vault, which to our senses seems to move round the earth. If any star seen by the direction of the sight-rod does not appear on the chart, the observer has seen a planet, which of course is not placed there. And if any one wishes to know what will be the position of the stars at any time, he has only to adjust the instrument and consult it. He may know, moreover, at what times the stars rise and set, and at what time those which do not set cross the meridian. The "Celestial Indicator" will tell him. The process of arranging the apparatus for observation is the work of a moment; and it may be done, once for all, by marking the places where the feet of the instrument set upon the ground or platform in order to replace the instrument. Very convenient for schools and amateurs, the best astronomers may find an instrument useful which dispenses with preliminary study, and enables one to read the heavens like a book.

CELESTIAL DYNAMICS.

DO THE PLANETS MOVE ROUND THE SUN?

IN this article the author undertakes to show that they do not, but that in their movement through space the sun and planets pass and repass each other, thus giving the appearance of movement in an orbit.

Our modern teachers of astronomy tell us that the sun moves through space with very great rapidity. They tell us this motion is from an original impulse. They tell us it is from an original impulse that the earth's progressive force is due, and from an original impulse it revolves on its axis. They are shut up to this notion of original impulse in all these cases, because the theory of movement in an orbit demands it. If the sun moves by an attractive force, that force would be an element of discord among accepted theories.

And now to guard against misapprehension. The principles of the *Principia* are right, and they explain the earth's motion, whether it has an orbit or not. All honor to Newton. We accept his principles, but he applied them to real movement of the planet around the sun *in an orbit*. This required either a sun stationary, or moving by an original impulse, and that the other motions spoken of above were also by an original impulse. Such were Newton's conceptions, and no other can be entertained in harmony with the notion of revolution in an orbit.

There is but one objection to this theory, if we admit these postulates concerning original impulse (an anomaly in nature). That objection is this: the time of the earth's passage from equinox to equinox by way of aphelion is so near the same as from equinox to equinox by way of perihelion. These times are to each other about as 21 to 20; thus requiring that the earth's orbit be very near a circle, and that its velocity have very little variation.

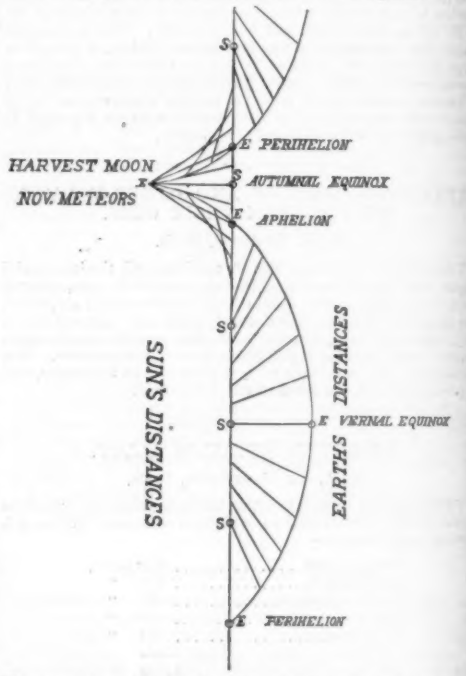
But if this objection amounts to nothing, it does amount to something that in a universe so full of attraction, and of forces operating to produce results, we are obliged to discard the notion of continuous forces, and to fall back on that of original impulse, to account for the movement of the sun and planets. Science should outgrow the idea that an original impulse keeps the celestial machinery in motion. If we can find laws in physical science, and mechanics for all planetary motion, shall we not hail the discovery, and assign the idea of original impulse, and whatever else goes with it, to a place among the outgrown relics of the past?

If the sun moves in its course by an attraction, drawn by some forward pull, that pull is a force likewise acting on all the planets of the solar system. And if the planet moves round the sun *in an orbit*, that pull would interfere with its annual and diurnal motion. The result of that pull on annual motion would be to break it up, and throw the planet in upon the sun. The result of it on diurnal motion would be to cause rotation in one direction while on one side of its orbit, and to change the rotation to the opposite direction while on the other side. For these reasons, astronomers, believing that the planets move round in an orbit, have held to the theory of motions from an original impulse.

I submit the following as the solution of this problem: Planets do not have orbits, as has been supposed, nor do they move round the sun; but in their paths they have perturbations, minor and major, the minor being produced by the planets, the major by the sun. The apparent annual revolutions result from changes to right and left of the sun's path, and from great inequality of velocity while at the different sides of that path. This inequality results from the sun's attraction, at one time co-operating with and at another time operating against the force by which all are impelled forward, the sun at one time hurrying the planet up, at another time holding it in check.

While there is no moving in an orbit, there is in the relative movements an apparent orbit, and all the functions of the ellipse. So that all the data on which astronomers have based their calculations remain intact.

The annexed plate explains the relative positions of the sun and earth, or of any ruling and subordinate planet.



Here you have their paths and relative positions for one year and one month. While the planet is passing from perihelion to aphelion it passes the sun, overtaking him at the vernal equinox, being now on the right of his path. At aphelion it crosses his path, but still goes forward with retarded velocity. And now at the autumnal equinox the sun passes the planet. The sun's motion is nearly constant. The planet has its greatest velocity at the vernal equinox, its least at the autumnal. The sun and all the planets are ever pressing forward. While the planet is to the right its velocity is greatest, while to the left the sun's velocity is greatest. Thus they pass and repass. The plate explains the harvest moon, and may give a hint on the November meteors.

And now what have we gained? Much every way. If we are told that the distinction between relative and absolute motion has ever been recognized, we answer we have shown the connection between these two. We have obtained more just conceptions of absolute motion, and have brought absolute motion to the front, as it is from it that we are to discover the workings of the celestial machinery. False conceptions of this very thing have to this day hedged up the way to such discovery. Throwing aside all reliance on original impulse, only give us an attractive force to move the sun and his system of planets on through space, and their own attractions upon each other, and we have all that is needed to account for all the motions of all the planets. The apparent annual revolution is accounted for as already explained. The diurnal revolutions are the result of two angular forces—the forward pull and the sun-ward pull. The path of the planet, its velocity, and its rotation, are each resultants from these. And here we have the conditions to give constant rotation amid inconstant velocity.

The planet revolves on its axis, because the pull from the sun and the forward pull are forces operating on different sides of its centre of gravity, except at two seconds of time in each year. This tendency to cause rotation will be strong or weak, according to the diameter of the planet, and to the relative power of the two forces.

If our scheme requires that heat is a factor in gravitation, we accept and avow it. As we understand it, all the attractions and repulsions in physics have but one law. The law which governs in the contraction and expansion of solids, fluids, and gases, which governs in the uniting or separating of molecules and atoms, is the same that fixes the locality of the several planets, and that assigns them their measure of influence one upon another. Without going into any lengthened statement, I will here venture to say that all those satellites whose motions are *reverse* will be found hotter than their primaries. And in this fact the philosopher will see *reason* for this reverse motion. The brevity of this article forbids detailed statement, and especially argument. If pressing engagements permit me to finish the preparation of a book begun one year ago, I may give the processes and inductions leading to these positions, and to others still more startling.

JAMES W. HANNA.

MT. VERNON, IOWA, July 31, 1876.